Branson/IPC Model 3000

PLASMATEK LABS
INCORPORATED

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SYSTEM QUALITY ASSURANCE RECORD

50 Hz _____ 60 Hz X

•System Nomenclature: BRANSON/IPC 3000 Plasmatek Invoice No: _____

•Customer: Key Assets Ship on/before: _____ Purchase Order #: 010226-02

•RF GENERATOR

•Model: PM119 S/N # 5332-21 Rated Power _____ Max. Power: _____

	No Power:	Rated Power:	Max. Power:
Plate Voltage	2.58 KV	2.36 KVDC	
Grid Bias Voltage	-90 VDC	-64 VDC	
PA Current	∅	-.40 VDC	
Osc. Plate Current	.98 VDC	4.7 VDC	
Screen Voltage	∅	1.4 VDC	

Minimum Line Voltage for Rated Output: 110 VAC

Date Tested: 6-26-01 Burn In: 30+ Hours

Q.A [signature] Mechanical Inpection BA Electrical Test [signature]

•TREATMENT CONSOLE

Leak Test BA [signature] Torrmeter Calibration [signature] Vacuum Trig. Adjust. BA Powermeter Calibration [signature] Mechanical Inspection BA [signature]

Q.A [signature] RFI Automatch Adjust. BA Programmer Time Check BA Temp. Cont. Check N/A

Uncapped Base Pressure 22μ Pressure Increases to 31μ IN 3 Min/Sec.

Capped Base Pressure _____ Pressure Increases to _____ IN _____ Min/Sec.

ACCESSORIES

INSTRUCTION MANUAL

IPC 3000 SERIES PLASMA SYSTEM

1.0 INTRODUCTION

1.1 Description:

The IPC 3000 Series Plasma Systems generate a low pressure, low temperature gaseous plasma. In this machine plasma reactions, such as ashing, etching, and polymer surface modification can be performed quickly and reproducibly. The machine comprises a source of RF electrical power, means for coupling the RF power into the plasma treatment chambers, and a system to control the flow of reactant plasma gases.

The reactor treatment chambers vary from model to model in this series. Each chamber has a hinged access door through which samples are inserted or removed. The door is sealed with a bell jar gasket. The RF generator in this series provides RF power, dynamically regulated to maintain constant level into a normal load or to limit power output if the load is removed.

Two seperate units are provided which are interconnected by gas hoses and electrical cables. These are the RF GENERATOR and the REACTOR CENTER. The REACTOR CENTER contains the Reactor Chambers, the Gas Controls, RF Power Matching Controls, and Timer.

1.2 Specifications:

Specifications for the IPC 3000 Series of plasma machines depends on two sets of specifications for the two individual units which make up the system. Reactor center specifications are given on the following page. Specifications for the generator-control console are given in the generator section of this manual.

1.2 (Continued)

MODEL --------- PM _____ REACTOR CENTER

Enclosure Dimensions ---- Width _____ inches

Height _____ inches

Depth _____ inches

Reactor Chamber Dimensions ----- Diameter _____ inches

Length _____ inches

Weight _____ pounds

Weight ------------------- _____ pounds

Power Rating -------- _____ watts continuous input

Impedance Control ------- Matches from 10 to _____ watts to present input impedance of 50 ohms at input connector.

Operating Pressure Range ---------- 0.1 to 5 torr

Pressure Transducer ---------- thermocouple type

Vacuum Seals ------ Silicone "O"rings and silicone bell jar gasket.

Flow Meters ---------- Range - 0 to 900cc/min.

Timer ---------- Selects process period

Chart Recorder ---- (Optional) provided with DPS-1000 only; 1div./min. range - 0 to 1mA; input impedance - 100 ohms.

1.3 Equipment Supplied:

The following equipment is supplied to:

_____

Under P.O. Number: _____

Model No. IPC _____ comprising:

PM _____ R.F. Generator (Serial No._____)

PM _____ Reactor Center (Serial No._____)

Cables as follows:

Instruction Manual

Vacuum Pump (Serial No._____)

Special Features:

1.3 Equipment Supplied:

The following equipment is supplied to:

_____

Under P.O. Number: _____

Model No. IPC _____ comprising:

PM _____ R.F. Generator (Serial No._____)

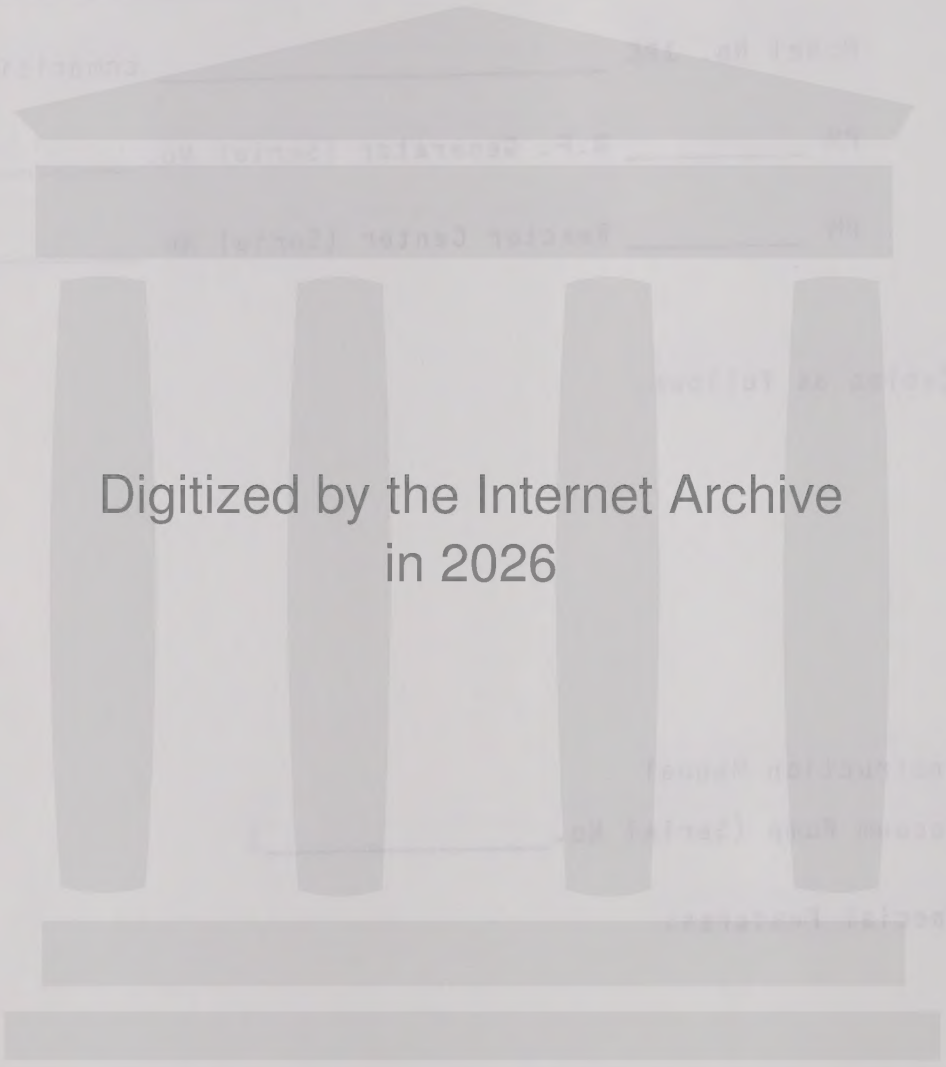
PM _____ Reactor Center (Serial No._____)

Cables as follows:

Instruction Manual

Vacuum Pump (Serial No._____)

Special Features:



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2.4 Gas Connections:

The unit requires industrial gases at an input pressure of 5 PSIG.* A common single stage gas regulator plus gas cylinder may be used. (A typical regulator would be a Matheson Gas Products #IL-540 or equal). Plastic or metal tubing may be run from the gas regulator to the fittings at the back of the Reactor Center.

There are two 1/4" Swage-lock fittings in the back of the Reactor Center. One is for the reactive gas and one is for the purge gas, and they are so marked.

(Insure that the gas connections are tight).

2.5 Vacuum Connections:

The mechanical vacuum pump is supplied with its own installation instructions. These should be referred to for installation, addition of pump oil and attachment of the power cord.

The exhaust manifold extension protrudes from an opening in the rear of the Reactor Center. The flexible hose provided is coupled directly from the exhaust manifold extension to the vacuum pump. Hose clamps are provided for each hose connection.

(Insure that the hose clamps are tight.)

3.0 OPERATION

3.1 General:

A nominal 115 volt, 20 amp service outlet is required for the IPC 3000 Series Plasma System. Under ordinary load conditions the service will be called on to deliver 15 amps maximum.

The IPC 3000 Series Plasma System uses a standard three pin "U" ground plug. If the wall outlet is not supplied with the proper receptacle, it will be necessary to provide the proper receptacle. It is recommended that the outlet be checked with a tester to insure that it is wired properly.

The IPC 3100 system uses a 208-240V 20a 3 wire circuit.

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*See process tips section for recommended parameters.

3.2 Controls and Indicators:

The operating controls and indicators of the IPC 3000 Series Plasma System are located on the front panels of the generator and the Reactor Center. The connectors are on the rear panel. In the text all operating controls and rear panel connectors are described in the following tables:

3.2.1 Generator Front Panel Controls and Indicators

1) AC POWER ON/OFF SWITCH..... Applies AC power to the generator.

2) AC POWER INDICATOR..... The lamp above AC POWER switch lights when the AC POWER is ON.

3) READY INDICATOR..... The lamp to the left of the RF POWER switch lights approximately three minutes after AC POWER is turned ON, indicating the generator is warmed up and ready to provide RF POWER.

3.2.2 Generator Rear Panel Connectors

1) AC POWER CORD..... A three-wire cord through which the line power is obtained.

2) VACUUM TRANSDUCER CONNECTOR ..... Allows the vacuum transducer which drives the vacuum meter to be attached to the generator. It supplies power to the transducer and couples the return signal to the meter.

3) AUXILLIARY POWER OUTPUT CONNECTOR..... Supplies AC power to auxilliary units and connects to an interlock switch which removes RF Power when the switch is activated. Also supplies the vacuum trigger signal from the generator to the Reactor.

3.2.2 (Continued)

4) RF POWER OUTPUT CONNECTOR..... Connects generator output power to the load via UHF type connector.

3.2.3 Reactor Center Front Panel Controls and Indicators

1) MODE CONTROL SWITCH..... Selects either automatic or manual operation.

2) START PUSHBUTTON..... Starts automatic sequence.

3) RESET PUSHBUTTON..... Actuates purge at end of automatic sequence.

4) VACUUM ON/OFF SWITCH ..... Actuates exhaust valve for chamber evacuation.

5) PURGE ON/OFF SWITCH ..... Controls entrance of purge gas.

6) FLOW NEEDLE SWITCH ..... Sets flow rate of reactant gas.

7) GAS ON/OFF SWITCH ..... Actuates gas flow.

8) FLOWMETER ..... Measures gas flow in cc/min.

9) MATCHING FINE*..... Fine control for impedance matching network.

10) MATCHING COARSE*..... Coarse control for impedance matching network.

11) TIMER ..... Setable timer to control run time in automatic mode.

12) RF POWER ON/OFF SWITCH ..... Allows RF drive to be applied to Generator power amplifier. In the ON position the RF power is determined by the setting of the level control.

*Not provided if system includes AutoMatch option.

3.2.3 (Continued)

13) RF POWER LEVEL CONTROL ..... Provides continuous control of RF power from zero to the maximum available.

14) REFL/FWD SWITCH ..... Selects whether the wattmeter displays Forward or Reflected power.

15) VACUUM METER..... Reads Reactor Chamber Pressure in Torr.

16) POWER METER ..... Reads the power passing through the output connector of the generator. When the REFL/FWD switch is in the FWD position the meter reads power transmitted to the load. When the REFL/FWD switch is in the REFL position the meter read power reflected by the load.

3.2.4 Reactor Center Rear Panel Connectors

1) VACUUM TRANSDUCER CONNECTOR ..... This is an octal plug which mates with the socket of the vacuum transducer cable to the generator.

2) RF CABLE CONNECTOR ..... UHF type connector through which RF power to the reactors is obtained.

3) AUXILIARY POWER CONNECTOR ..... Connects to generator and provides power for fans, solenoid valves, lights, RF interlock, and vacuum trigger.

4) EXHAUST MANIFOLD EXTENSION ..... Hose from the vacuum pump fits over this extension.

3.2.4 (Continued)

5) GAS INLET CONNECTORS (3) ..... Gas to the reactor chambers enters through these connectors.

3.3 Manual Operation of the IPC 3000 Series Plasma Machine:

3.3.1 General Comments*

The following sections deal with the operation and use of all the controls and functions of the IPC 3000 Series Plasma Machine. These procedures are a necessary preliminary to the fully automatic programmed operation described in the following section of this manual. At this point the modules should be completely connected by cables and the gases installed as described in the previous sections. The switches on the generator should be in the positions described below:

AC POWER ..... OFF

On the Reactor Center the switches should be in the following position:

R.F. POWER ..... OFF
POWER LEVEL CONTROL ..... Fully Counterclockwise
R.F. METER-
FORWARD/REFLECTED ..... FORWARD
FLOW ON/OFF ..... OFF
FLOW METERING VALVE ..... Fully Clockwise
VACUUM PURGE ..... OFF
VACUUM ..... OFF
MODE ..... MANUAL
TIMER ..... Set to Zero
FINE MATCHING ..... Arbitrary Position
COARSE MATCHING ..... Arbitrary Position

Check the gasket on the Reactor Center. Remove any foreign material and see that gasket is s seated snugly against Reactor Chamber lips. Close Reactor doors.

Plug in the R.F. Generator and the vacuum pump. Turn ON the vacuum pump.

To operate the plasma system, turn ON the AC POWER switch on the generator. The amber light should now be lit and the fans should be operating.

* See process tips for recommended parameters.

3.3.2 Chamber Evacuation

Throw the vacuum switch to the ON position. The pump noise will noticeably increase and the Reactor doors will be sealed against the gasket. Observe the vacuum gauge on the generator, it should fall below 0.2 torr within a few minutes.

3.3.3 Gas Flow Control

Turn on the Gas flow control and adjust to the desired flow rate. As flow is adjusted, observe the torrmeter until the pressure stabilizes at about 1 torr.

3.3.4 R.F. Power Level Control & Matching

If the READY lamp has lit, turn on the R.F. power switch on the generator. Turn the R.F. level Control clockwise and observe the R.F. Power Meter.

3.3.4.1 Systems with AutoMatch Option

The AutoMatch will automatically cause the plasma to strike and then tune. The operator need only adjust the R.F. level to the desired value. Verify that a match exists by switching the R.F. switch to REFL and observe that the "reflected power" on the lower scale is less than 2% of the forward power rating.

3.3.4.2 Systems with Manual Matching

Turn COARSE adjust counterclockwise until plasma ignites. Once the plasma is ignited and sustained turn the FINE and COARSE Impedance Matching Network controls until a maximum of forward power is obtained. The forward power is monitored with a FORWARD/REFLECTED switch on the generator. Then adjust for minimum of reflected power with both the COARSE and FINE controls simultaneously. The Matching Network is wide ranging, but must be set initially. Once set, only occasional adjustments will be needed to maintain a good match from run to run. A good matching condition is obtained when the reflected power is less than 5% of the forward power.

3.3.5 Review of the Initial Start Up and Manual Operation Procedures

1) Vacuum Pump ON.
2) Main AC power ON.
3) Vacuum ON to obtain low pressure.
4) R.F. switch ON and R.F. level set to desired value.
5) Gas flow ON and set to flow rate desired.
6) Match the impedance of the load.

3.3.6 Turning Off the Plasma and Purging the Chambers

To turn the plasma off at the end of a run and remove the samples from the chamber, perform the following steps in the listed sequence:

1) R.F. OFF (level control remains in the run Position).
2) Vacuum OFF
3) Purge ON.

3.3.7 Restarting the Plasma

1) Load new samples and close doors.
2) Purge OFF.
3) Vacuum ON (wait for pressure to decrease below about 0.2 torr).
4) R.F. ON.
5) Gas ON.

Note that these operations involve actuating the right switches. The gas flow and R.F. level have been set up in the previous run and the impedance matching remains the same from run to run.

3.4 Automatic Operation - Single Program:

3.4.1 Starting the Automatic Sequence

The following steps describe the operation of the IPC 3000 Series Plasma System in the automatic mode. The conditions of R.F. power level and gas flow should have been set up and established in the manual mode previously described in section 3.3.

1) MODE switch to AUTO.
2) R.F. ON.
3) Gas flow ON.
4) Purge ON.

3.4.1 (Continued)

5) If reset light comes on, push RESET button.
6) Set TIMER for desired run time.
7) Load samples and close door.
8) Push START button.

Step #8 above actuates a fully automatic sequence which consists of the following steps:

a. The chamber is pumped down to a preset vacuum level (about 0.2 torr).
b. The R.F. power will come on at this preset vacuum level.
c. The gas flow will start at this preset vacuum level.
d. The plasma will be sustained for the time set on the timer.
e. After the timer has run down to zero, the gas flow and the R.F. power go off.
f. The red light above the reset button comes on, along with a sonic alert to tell the operator that the cycle is complete.

3.4.2 Changing Samples in the Automatic Mode

The red light over the RESET button and the sonic alert signal the end of the automatic sequence. To change samples, push the RESET button. This actuates the purge and resets the timer. Once the chambers have returned to atmosphere, remove the samples, reload the chamber, and the machine is ready to run again.

4.0 MAINTENANCE

4.1 General:

This section covers procedures used to keep the IPC Plasma System operating at maximum efficiency. These procedures are primarily inspection and adjustment of all components on a periodic maintenance schedule. Maintenance of the R.F. Generator-Control Console is covered in the separate manual at the rear of this system manual.

4.2 Reactor Chambers:

The principal maintenance requirement in the module is to treat the Reactors and doors with care; do not slam or scratch or spill chemicals on the doors or in the reactors. When evacuated the reactors are under an atmospheric force of hundreds of pounds. Doors, reactors, and gaskets are easily cleaned with ordinary agents.

NOTICE

ALL QUARTZWARE SHOULD BE HANDLED WITH COTTON GLOVES

In case of breakage the reactors and doors can be readily replaced with new units.

4.3 Vacuum System:

The vacuum pump is the key to trouble-free operation of the vacuum system. Refer to the pump manual for information on oil changes, ballast adjustment, and general maintenance. "o" rings or gaskets damaged by extreme temperatures or corrosive gases should be replaced.

4.4 Flow Control:

The gas system is simple so that little trouble should be expected here. All joints should be checked for leaks with a soap solution if disconnected and remade. Swagelock fittings should be tightened one and one-quarter turns past finger tight. If the ball in the flowmeter gets dirty, the unit may be disassembled and cleaned. Watch for tiny parts. If valves fail to function, they may be disassembled and the gaskets cleaned or replaced.

4.5 R.F. Electrodes:

Electrodes should last indefinitely. If the reactors are run at extreme temperatures the Teflon support buttons may melt or flow, requiring replacement. They are snapped into perforations in a uniform pattern.

4.6 Impedance Matching Network:

As these parts are purely mechanical they should provide years of trouble-free service. If, through some accident, the inductor or capacitor contacts arc over to burn they will need to be replaced.*

*For systems with AutoMatch, see AutoMatch section for maintenance and calibration.

DIONEX GAS PLASMA SYSTEMS

ENGINEERING PARTS LIST

DWG. NO.	REV.
06158	E

REV	DESCRIPTION	DATE	CHK	APPR
E	E.O. #10888	9-9-80		PLD
D	E.A.R. #20388	9-5-80		PLD
C	E.O. #10655 MS	4-1-80	PB/JC	
B	E.O. #10812 REVISED SHTS 2 & 4	1/80	JC	JA
A	INITIAL ISSUE EO10707, EO10743	12/17/79		JA

REVISION LEVEL

DIONEX GAS PLASMA DIVISION
31159 SAN BENITO
HAYWARD, CALIF. 94544

DRAWN E.D.	DATE 12/17/79	TITLE REACTOR CENTER- PM 1813 (8" HARDWARE)	
CHECKED	DATE 12-17-79		
ENG.	DATE	A	DRAWING NO. 06158 REV. E
		DO NOT SCALE THIS DRAWING	

NEXT ASSY.

A05495 REV A

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
	WINDOW STOP	A 03162	4
	8" ELECTRODE INSULATOR	B 04434	8
	FLANGED AIR OUTLET	B 02596	1
	EXHAUST HOSE ADAPTER	B 02611	1
	AUTOMATCH PLUG BRACKET	B 02669	1
	FAN SCREEN	B 02799	1
	TRANSDUCER MOUNTING BRACKET	B 03110	1
	DOOR LATCH	B 03164	1
	WINDOW HINGE	B 03560	1
	DOOR STOP (LEFT SIDE)	B 03653	1
	SPRING DOOR TENSION	B 03752	2
	FOOT SUPPORT ELECTRODE FRAME	B 03931	4
	MIDDLE SUPPORT ELECTRODE FRAME	B 3932	2
	ELECTRODE SUPPORT FRAME	B 03933	4
	HANGER BRACKET ELECTRODE FRAME	B 03934	4
	VACUUM VALVE MOUNTING BRACKET	B 03935	2
	DOOR LATCH COVER	B 03937	1
	EXHAUST MANIFOLD	B 03163	1
	REACTOR FRONT PANEL PLATE	C 03538	1
	REACTOR DOOR, OUTER	C 03541	1
	INSIDE DOOR PLATE (LEFT HAND)	C 03542	1
	GUSSET	C 04013	2
	HINGE GUSSET	C 04014	1
	HORIZONTAL BAR	C 04223	2

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TITLE
REACTOR CENTER
PM 1813 (8" HARDWARE)

SIZE	DWG. NO.	REV.	CHK.	APPR.
A	06158	E		

DRAWN	DATE	SHEET 1 OF 4
JC	1/8/79	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
	TEFLON WINDOW SLIDE	C 04224	1
	FRONT PANEL	D 03537	1
	HOUSING ASSEMBLY	D 03546	1
	DECK AND SUPPORT ASSEMBLY	D 04004	1
	REAR PANEL	D 04097	1
	CHAMBER RETAINER	D 04230	1
	U.V. SHIELD	B 03579	1
	TEFLON PAD	C 04247	1
	BELLOWS 1" BRASS	B 04441	1
	CAPACITOR MOUNTING BRACKET	B 04425	1
	CAPACITOR MOUNTING BRACKET	B 04426	1
	AUTOMATCH "L" BRACKET	B 04418	1
	ELECTRODE ASSY	02666-005	4
	R/C FILTER ASSEMBLY	A 06979	1

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PM 1813 (8" HARDWARE)

SIZE	DWG. NO.	REV.	CHK.	APPR.
A	06158	E	MJ	

DRAWN	DATE	SHEET 2 OF 4
JC	1/8/79	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY
	CAPACITOR 100 Pf 5KV	1500-0189	2
	CONNECTOR FEMALE HOLLINGSWORTH #SO-5077	2120-5077	1
	CONNECTOR MALE HOLLINGSWORTH #SO-5078	2120-5078	1
	ASCO VALVE	5930-0013	1
	TUBE VACUUM GAUGE (HASTING #DV4D)	5930-0322	1
	BULKHEAD 1/4" TUBE 1/4".PIPE	5970-0400	1
	BULKHEAD RETAINER	5970-0024	1
	SWITCH MOMENTARY MICROSWITCH 23 1	5100-0017	1
	O-RING 1"	5900-0120	3
	O-RING 3/4"	5900-2116	3
	BELL JAR GASKET	C 04946	1
	THOMAS CLAMP 28/15"	5950-0001	3
	THOMAS CLAMP 35/25"	5950-0002	1
	BRASS NIPPLE 5" X 3/4" NPT	5960-0065	1
	DOOR HANDLE	2400-0012	1
	FAN, HOWARD #3450	2600-0004	1
	FURNITURE LEVELER	2800-0005	4
	RELAY LABELS	6100-0006	1
	REAR PANEL LABELS	6100-0008	1

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TITLE
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SIZE	DWG. NO.	REV.	CHK.	APPR.
A	06158	E		

DRAWN	DATE	SHEET 3 OF 4
JC	1/8/79	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY
	9-1/2" SQUARE QUARTZ WINDOW	C 04478	1
	8" X 13" QUARTZ CHAMBER	D 04329	1
	28/15" TRANSDUCER BALL QUARTZ	B 04448	1
	GLASS TEE	5970-0343	1
	BLIND BALL QUARTZ	B 04444	1
	EXHAUST MANIFOLD	C 04384	1
	35/25" GROUND GLASS SOCKET	B 04439	1
	ETCH TUNNEL		1
	PM 702 AUTOMATCH ASSY	D 04491	1

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TITLE

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SIZE	DWG. NO.	REV.	CHK.	APPR.
A	06158	E		

DRAWN	DATE	SHEET 4 OF 4
JC	1/8/79	

DIONEX GAS PLASMA SYSTEMS

ENGINEERING PARTS LIST

DWG. NO.	REV.
04542	F

REV	DESCRIPTION		DATE	CHK	APPR
F	E.O. #10836	MS	4-17-80	R. C	[illegible]
E	TYPED	M.M.	8/24/79	"	[illegible]
D	E.O. #10513	K.G.	3/28/79		
C	REVISED	S.S.	8/10/78		
B	REVISED	S.S.	8/10/78		
A	INITIAL ISSUE	J.V.	7/25/78		

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DRAWN	DATE	TITLE
S.SLOSEK	8/10/78	3000 SC SERIES CONTROL PANEL ASSEMBLY
CHECKED	DATE	
ENG.	DATE	

D	DRAWING NO.	REV.
	04542	F

DO NOT SCALE THIS DRAWING

NEXT ASSY.

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
REF	MANUAL	A 00133	1
1	PLUG BRACKET	B 02669	1
M2	TORRMETER, 0-760 TORR	A 02708	1
	MODUTEC		
M1	WATTMETER, 500 WATT	A 02712	1
	MODUTEC		
2	METER MOUNTING BRACKET, CENTER	B 02900	1
3	RELAY MOUNTING BRACKET	C 03785	1
4	CONTROL PANEL	C 03912	1
5	CONNECTOR MOUNTING BRACKET	C 03990	1
6	DECAL	C 04011	1
7	FLOWMETER MOUNTING BRACKET	B 04118	2
REF	SCHEMATIC	C 04123	1
8	METER MOUNTING BRACKET, SIDE	B 04356	2
9	BEZEL BAR	B 04405	1
REF	WIRING HARNESS	D 04543	1

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TITLE
3000 SC SERIES
CONTROL PANEL ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04542	F	/	

DRAWN	DATE	SHEET 3 OF 6
S. SLOSEK	8/10/78	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
C6	CAPACITOR, .01uF 500V	1500-0001	1
	SPRAGUE #5GAS-S10		
10	RELAY SOCKET, 11 PIN F	2110-0046	1
	AMPHENOL #77-M1P-11		
11	SOCKET, 8 PIN OCTAL	2110-0170	3
	CINCH JONES #8AM		
12	CONNECTOR, FEMALE DISCONNECT	2120-5077	4
	HOLLINGSWORTH #SO-5077		
13	CONNECTOR, MALE DISCONNECT	2120-5078	4
	HOLLINGSWORTH #SO-5078		
J5	CONNECTOR, 5 PIN FEMALE	2130-0020	1
	AMPEHNOL #126-218		
P1	RECEPTACLE, 14 PIN MALE	2152-2215	1
	AMPHENOL #MS-3102A-22-19P		
J2	CONNECTOR, 4 PIN FEMALE	2152-2417	1
	AMPHENOL #MS-3106A-14S-2S		
E1-E4	TERMINAL, INSULATED	2160-0207	4
	USECO #1417-9		
M3	TIMER, 1 HR. 60 HZ 120V	2200-0004	1
	EAGLE #HP 56A6		
14	KNOB, 3/4" DIA.	2400-0001	1
	ALCO #DPN-700-AB		
			4

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TITLE
3000 SC SERIES
CONTROL PANEL ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04542	F		

DRAWN	DATE	SHEET 4 OF 6
S.SLOSEK	8/10/78	

A 04289 REV

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
16	M-F THD SPACER	2860-8257	4
	H.H. SMITH #8257		
17	FLOWMETER, 900cc/MIN.	2900-0370	1
	LABCREST #10A1460MB11D		
DS1	LAMP, AMBER 115V	3900-0001	1
	DIALCO #507-4537-1433-640		
DS2	LAMP, RED 115V	3900-0002	1
	DIALCO #507-4537-1431-640		
18	LAMP HOLDER	3900-0107	2
	DIALCO #250-7445-14-504		
K2, K4	RELAY, 120V	4500-0009	2
	P-B #KRP-11A		
K1	RELAY	4500-0010	1
	SIGMA #42R02500S-S1L		
K3	RELAY 3PDT 120V 5A	4500-0165	1
	P-B #KRP-14A		
R1	POTENTIOMETER 100K 2W	4750-0001	1
	OHMITE #CMU 1041		
PB1-2	SWITCH, SPDT	5100-0002	2
	C & K #8121		
S8	SWITCH, DPDT	5100-0004	1
	C & K #7201 P		
S1	SWITCH, 4PDT	5100-0005	1
	C & K #7401P		

DIONEX
GAS PLASMA DIVISION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE
3000 SC SERIES
CONTROL PANEL ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04542	F		

DRAWN	DATE	SHEET 5 OF 6
S. SLOSEK	8/10/78	

A 04288 REV

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
S2-4, 7	SWITCH, SPDT	5100-0027	4
	C & K #7101P		
SV3, 5	VALVE, SOLENOID N.C. 120V	5930-0002	2
	SKINNER #B02A1052		
19	HEX NIPPLE, 1/8 P	5965-1802	2
	IMPERIAL #122B		
20	BULKHEAD RETAINER	5970-0024	3
	SWAGELOCK #S-402-61F		
22	BULKHEAD FITTING 1/4T	5970-0903	3
	PARKER #4-4-DBZ-B		
21	STREET TEE 1/8P	5970-0229	1
	CAJON #B-25T		
23	MALE ELBOW, 1/4T X 1/8 P	5970-1306	2
	PARKER #4-2-CBZ-B		
24	MALE BRANCH TEE, 1/4T X 1/8P	5970-2003	1
	PARKER #4-4-25BZ-B		
25	RING TERMINAL 22 GA X #10 STUD		4
	H.H. SMITH #4803 NON-INS		
26	LOCKING TERMINAL LUG		1
	H.H. SMITH #1416-6		
27	RING TERMINAL 22GA X #6 STUD		6
	H.H. SMITH #4801		
28	CABLE		A/R
	BELDEN #8763		

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D	04542	F	E	

DRAWN	DATE	SHEET 6 OF 6
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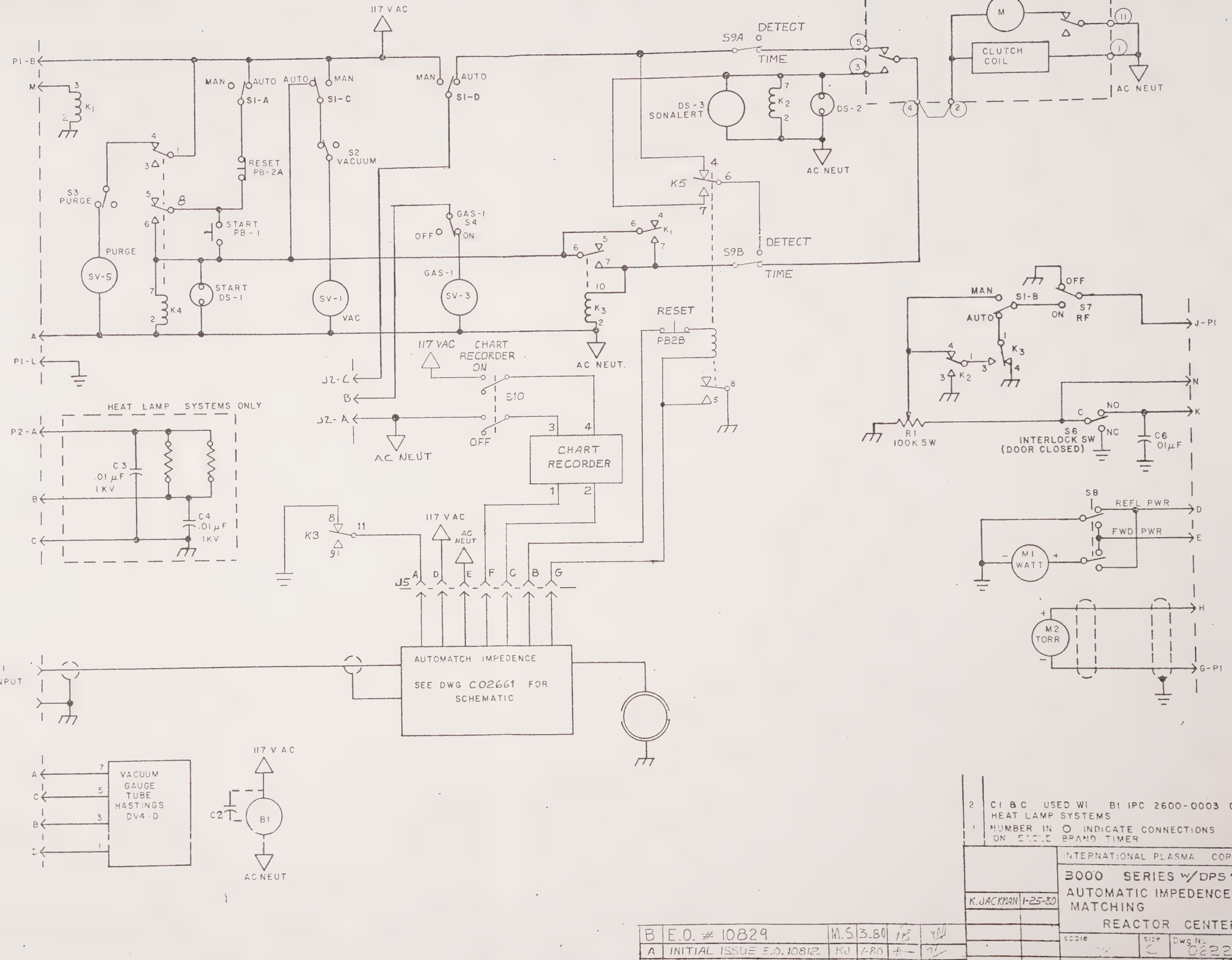


2 C1 & C HEAT LAMP SYSTEMS — USED W/ B1 IPC 2600-0003 ONLY

1 NUMBER IN ○ INDICATE CONNECTIONS ON EAGLE BRAND TIMER

INTERNATIONAL PLASMA CORP

3000 SERIES w/DPS 1000

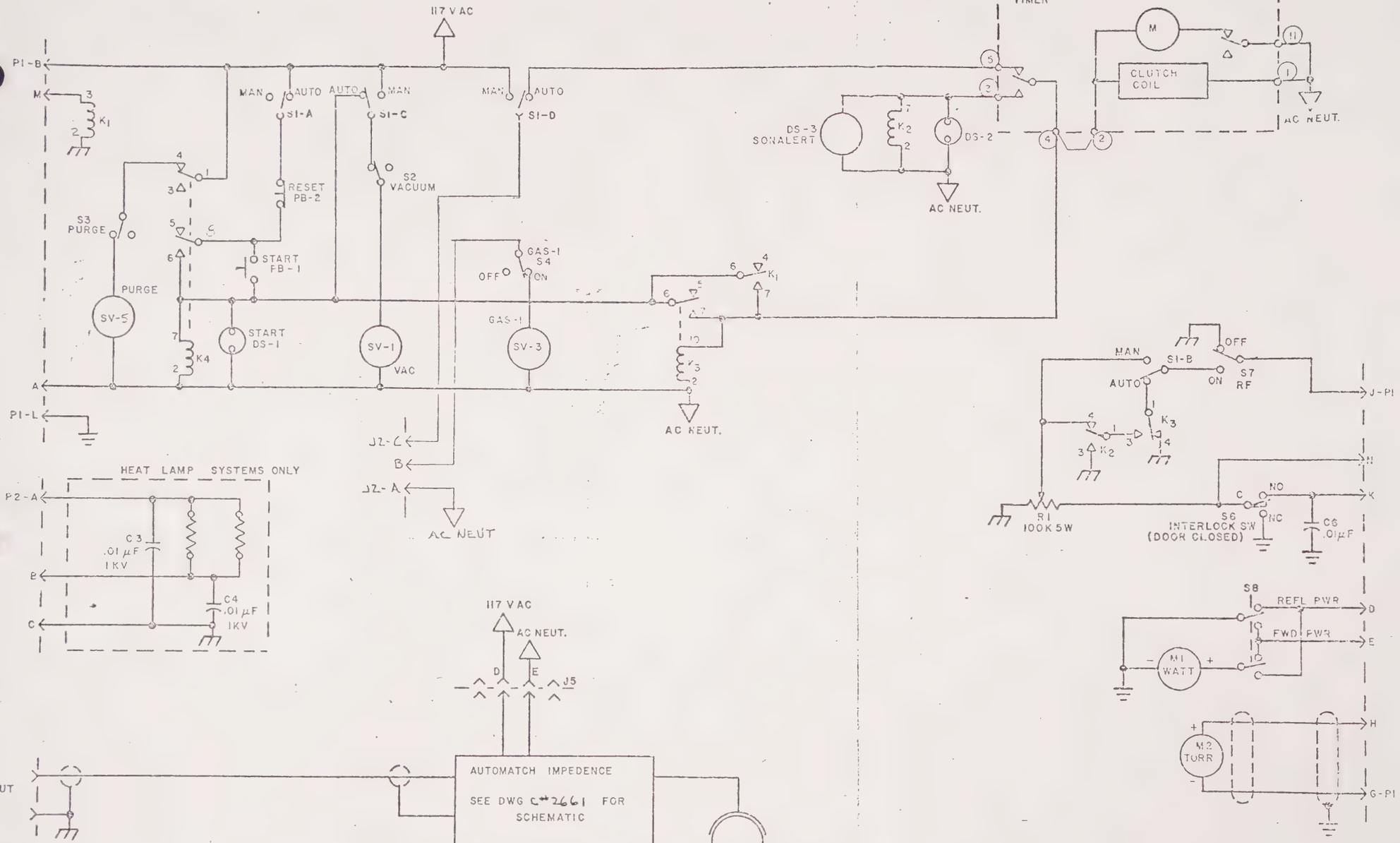
AUTOMATIC IMPEDENCE MATCHING

REACTOR CENTER

K. JACKMAN 1-25-80

REV	DESCRIPTION	PREP	DATE	APPR	CK
B	E.O. # 10829	M.S.	3-80		
A	INITIAL ISSUE E.O. 10812	KJ	1-80		

SCALE — SIZE C — DWG NO. 02222 — REV B — SHEET 1



3

2 C1 & C USED W/ B1 IPC 2600-0003 ONLY HEAT LAMP SYSTEMS

1 NUMBER IN INDICATE CONNECTIONS ON EAGLE BRAND TIMER

INTERNATIONAL PLASMA CORP

3000 SERIES
AUTOMATIC IMPEDENCE MATCHING
REACTOR CENTER

SCALE | SIZE C | DWG NO 34123 | C

REV	DESCRIPTION	INITIAL & DATE

BRANSON/IPC
a SmithKline company

BRANSON INTERNATIONAL PLASMA CORPORATION

INSTRUCTION MANUAL

for

PM 701-702-703 /IPC

AUTOMATCH W/DPS 1000

A00110 Rev D
August 9. 1977

31172 Huntwood Avenue
P.O. Box 4136, Hayward, CA 94544
(415) 489-3030 Telex: 337-759

INSTRUCTION MANUAL
for
IPC PM 701-702-703
AUTOMATCH

1.0 INTRODUCTION

1.1 Description

The R.F. Generator is designed and calibrated to drive a fixed 50 ohm resistive load. However, the reactor and plasma present a resistive/capacitive load. Its amplitude and phase depend upon the type and size of chamber and upon various operating parameters, e.g. power level, pressure, type of gas, and temperature. Therefore, a network which matches the impedance of the reactor to the desired 50 ohms is provided in each Reactor Center. The AutoMatch system continuously and automatically adjusts the matching network over the full operating range of the Reactor Center.

The matching network is a capacitor-inductor-capacitor pi network. Both amplitude and phase of the impedance at the input to the network must be correct, i.e. 50 ohms and zero degrees. This requires the adjustment of two components. Therefore both capacitors in the network are variable and are motor-driven. The series inductor is fixed.

As in any parallel tuned RLC network there are two values of capacitance for resonance (phase equals zero). In this application the only legitimate resonance is one where the magnitude of the input current is less than the magnitude of the current in the input capacitor, i.e. $/I_{in}/ < /I_{ci}$, (See Figure A). AutoMatch insures that this relationship holds by automatically increasing Ci and Co if $/I_{in}/ > /I_{ci}$.

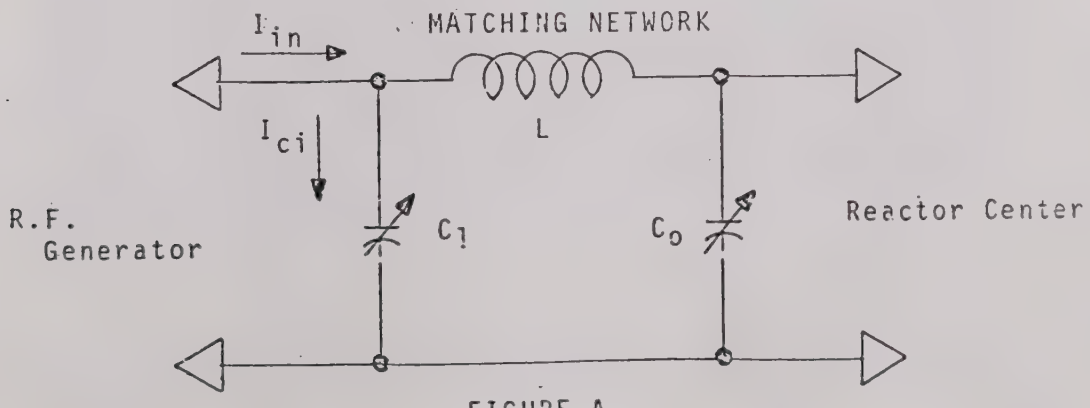


FIGURE A

2.0 OPERATION

The operation of AutoMatch is completely automatic over the functional range of the Reactor Center and requires no operator intervention.

3.0 FUNCTIONAL DESCRIPTION

3.1 Functional Inclusions

An R.F. Coupler which detects the inpedance at the input to the matching network, and provides signals indicative of errors in both amplitude and phase. The coupler also detects $/I_{in}/$ for subsequent comparison to $/I_{ci}/$.

3.2 An amplifier section which amplifies the error signals, i.e. amplitude error and phase error, and amplifies the signal comparing $/I_{ci}/$ and $/I_{in}/$.

3.3 A motor and gear drive section mechanically coupled to the rotors of the air variable capacitors of the matching network. The motors are driven by the appropriate amplifiers in the amplifier section, adjusting the capacitances for minimum error signals.

3.4 The pi matching network consisting of the variable capacitor at the input and output terminals and the series fixed inductor. It also includes circuitry to detect $/I_{ci}/$ for processing with $/I_{in}/$ in the amplifier section.

4.0 CIRCUIT DESCRIPTION

Refer to drawing C02661 for the schematic of AutoMatch.

4.1 R.F. Coupler

The R.F. Coupler, shown schematically within the dashed lines, is an arrangement of lumped components and distributed components mechanically arranged to generate D.C. voltages which, when properly combined, yield the appropriate error signals for both amplitude and phase. The phase error is proportional to the sum of voltages Vp1 and Vp2, which are the D.C. voltages developed on capacitors C205 and C204, respectively. The amplitude error is proportional to the sum voltages Va1 and Va2, which are the D.C. voltages developed on capacitors C207 and C206, respectively. Va1 is proportional to the total input current.

4.2 Phase Error Amplifier

The voltages Vp1 and Vp2 are summed algebraically by the phase error amplifier through input resistors R101 and R102. R108 is a potentiometer to adjust for any minor misalignment in the coupler. The phase error amplifier is a feedback amplifier comprised of A101 with output buffer power transistors Q101 and Q102. The amplifier drives the D.C. motor M202 which is mechanically geared to the rotor of the variable air capacitor C202*, the output capacitor of the matching pi network. The forward gain of the amplifier is determined by the voltage feedback via R116.

4.3 Limit Switches

Switch S201 and S202 are "limit" switches positioned to limit the range of rotation of the rotor of variable air capacitor C202. If the motor is driven by a positive voltage, the capacitor rotor will rotate to its extreme position when S202 is opened. Diode CR206 then prevents current through the motor until the amplifier output voltage is reversed. Limit switch S201 and CR205 similarly restrict the range of capacitor rotation for negative voltage drive.

4.4 Amplitude Error Amplifier

The amplitude error amplifier is identical to the phase error amplifier, driving D.C. motor M201 which is geared to the rotor of variable air capacitor C201*. Capacitor C201 with the fixed capacitors C211 and C212 comprise the input capacitance of the pi matching network. The current through the input capacitance (referred to previously as I_{ci} and ci respectively) is detected by virtue of the voltage across the "gimmick" inductor and rectifier diode CR209. The resulting D.C. voltage Vi is added algebraically with Va in amplifier A101 through input resistor R121, R123, and potentiometer R122. If the input current, represented by Va, exceeds I_{ci} the output of amplifier A101 becomes positive polarity. Diodes CR102 and CR101 then become forward biased driving the outputs of both error amplifiers positive. This results in C201 and C202 being driven to maximum capacitance.

4.5 Power Supply

Supply voltages B+ and B- of +15 and -15 volts respectively, are generated by two full wave rectifiers comprised of T1, capacitors C3, C4, and a diode bridge.

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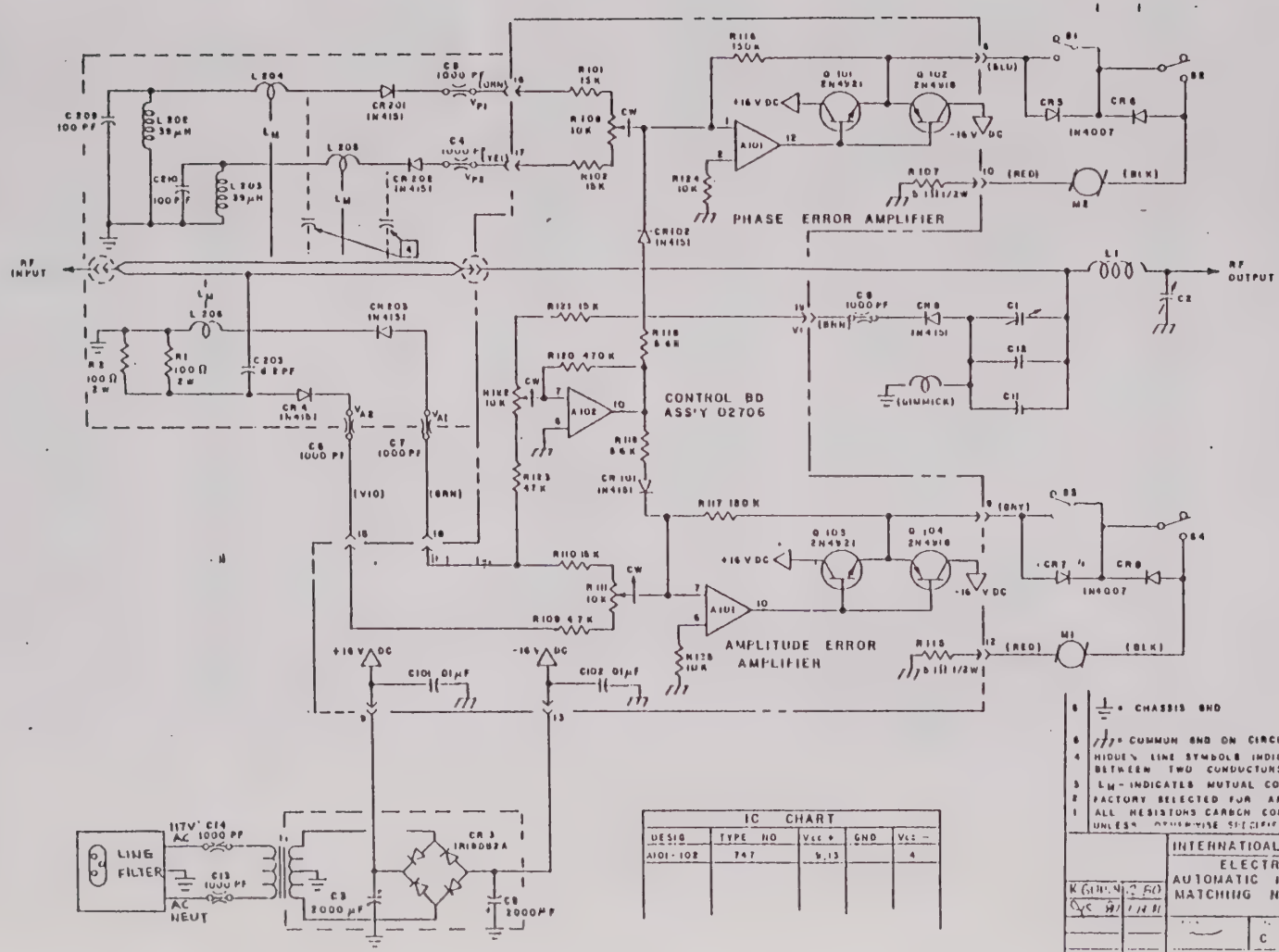
* For PM702 and PM703 the reference designator for C201 is C215 and the reference designator for C202 is C216.



IC CHART				
DESIG	TYPE NO	Vcc +	GND	Vcc −
A101 - 102	747	9, 13		4

5	⏚ = CHASSIS GND
6	= COMMON GND ON CIRCUIT BD.
4	HIDDEN LINE SYMBOLS INDICATE CAPACITANCE BETWEEN TWO CONDUCTORS
3	L_M - INDICATES MUTUAL COUPLING
2	FACTORY SELECTED FOR APPLICATION
1	ALL RESISTORS CARBON COMPOSITION 1/4 W UNLESS OTHERWISE SPECIFIED

INTERNATIONAL PLASMA CORP.

ELECTRICAL SCHEMATI

AUTOMATIC IMPEDENCE MATCHING NETWORK PM 708

C | 06962 | A

5.0 MAINTENANCE

WARNING: HIGH R.F. VOLTAGES EXIST THROUGHOUT THE UNIT. R.F. POWER SHOULD BE REMOVED DURING MAINTENANCE.

5.1 Electrical

All R.F. Coupler and Potentiometer alignments are made at the factory and require no further adjustment.

5.2 Mechanical

For ease of maintenance and to protect the motor driven gear heads, each drive train includes a slip clutch. The D.C. motors, gear heads, spur gears, slip clutch, and variable capacitors are precisely positioned at the factory. If it becomes necessary to replace any of these parts, exercise care in mating the spur gear on the capacitor shaft with the nylon slip clutch gear. The gear teeth should engage approximately 80-90% without binding for a full 360 rotation.

5.2.1 Excessive backlash, symptomized usually by a system oscillation (or hunting) may be caused by loose gears or set screws and/or improperly meshed gears.

5.2.2 The slip force on the slip clutch assemblies is set at the factory. If readjustment is necessary, the spring tension should be set to require a motor current of 25 ma at 12 volts with the nylon gear in a fixed position.

5.3 Capacitor Replacement

If replacement of a variable capacitor, C201 or C202, becomes necessary the following should be observed:

5.3.1 The spur gear should be firmly set on the capacitor shaft.

5.3.2 The limit switch actuating arm should be firmly set on the capacitor shaft with the following orientation:

With the limit switch actuating arm set parallel to the AutoMatch baseplate, the capacitor rotor should be set for 50% capacitance. The limit switch actuating arm should be toward the outer edge of the baseplate, and the capacitor rotor should be toward the center of the baseplate.

5.4 Adjusting the Reflected Power

This adjustment should only be necessary in the event that the PM 701/702/703 is retrofitted in the field. Make the adjustment at one torr of oxygen and with an R.F. level of 300 watts per chamber.

5.4.1 Units Without DPS-1000

Refer to figure 6. There are three adjustable resistors in the auto tuner. These are accessible through a vertical slot in the rear panel of the Reactor Center, and the one of concern is R108, the center resistor. Observing the reflected power on the system power meter, adjust R108 for minimum reflected power. If the system "hunts" or oscillates, turn R108 clockwise until "hunting" ceases. The reflected power should be less than 6 watts.

5.4.2 Units with DPS-1000

Refer to figure 7. There are five adjustable resistors in the Auto tuner/DPS-1000. These are accessible through a vertical slot in the rear panel of the Reactor Center and the one of concern is R108, the second resistor from the top. Observing the reflected power on the system power meter, adjust R108 for minimum reflected power. If the system "hunts" or oscillates, turn R108 clockwise until "hunting" ceases. The reflected power should be less than 6 watts.

5.5 Tuning Procedure

5.5.1 Remove L201 and disconnect strap from coupler to C201.

5.5.2 Loosen motor clamp.

5.5.3 Disengage motor gears from C201 and C202 gears by pulling motor housings back into tuner body.

5.5.4 Gently tighten motor bracket to hold motors in place.

5.5.5 Open C201 to minimum capacitance position; keep it off both limit switches. There should be two 100pf ceramic tubular capacitors in the padder bracket of C201.

5.5.6 Open C202 to middle position.

5.5 (continued)

5.5.7 Refer to figure 2 for potentionmeter locations (R108, R111, & R122).

5.5.8 Remove A102.

5.5.9 Connect a 50 ohm dummy load directly to coupler output - nothing else should be connected to coupler output at this time.

5.5.10 Plug 701-702-703 into 117 volts AC supply.

5.5.11 Connect a 500 watt generator to coupler input.

NOTE: DURING THE FOLLOWING STEPS; COVER THE COUPLER SIDE ONLY WITH ALUMINUM SAFETY COVER TO PREVENT ACCIDENTAL CONTACT WITH HIGH VOLTAGES PRESENT IN THE R.F. COUPLER SECTION.

5.5.12 Turn generator on and up to 500 watts.

5.5.13 Adjust R108 until M202 turns clockwise (viewed from Gearhead end of the motor). Manually close switch S202, and observe that the motor does not stop rotating. Manually close switch S201 and observe that the motor stops.

5.5.14 Adjust R108 until M202 turns counter clockwise (viewed from gearhead end of the motor). Manually close S201 and observe that M202 does not stop. Manually close S202 and observe that the motor stops.

5.5.15 Adjust R108 until M202 stops. This will balance A101A for zero output.

5.5.16 Adjust R111 until M201 turns clockwise (viewed from the gearhead end of motor). Manually close S203, and observe that M201 does not stop rotating. Manually close S204 and observe that M201 stops.

5.5.17 Adjust R111 until M201 turns counter clockwise. Manually close S204 and observe that M201 does not stop rotating. Manually close S203 and observe that M201 stops.

5.5.18 Adjust R111 until M201 stops. This will balance A101B for zero output.

5.5.19 Disconnect AC power from PM 701/702/703. This will bleed supplies via M201 and M202.

5.5 (continued)

5.5.20 Turn off R.F. Power.

5.5.21 Disconnect 50 ohm dummy load.

5.5.22 Connect strap from 701 and 702 coupler output in C201. C201 should be the only thing connected at this point.

5.5.23 Install A-102 and reconnect to 117 volt AC supply.

5.5.24 Turn up R.F. to 50 watts.

5.5.25 Adjust R122 until neither M201 nor M202 rotate toward minumum capacitance.

5.5.26 Turn off R.F. Power.

5.5.27 Install L201.

5.5.28 Connect simulated load.
EXAMPLE: (refer to next page) Figure B.

5.5.31 (continued)

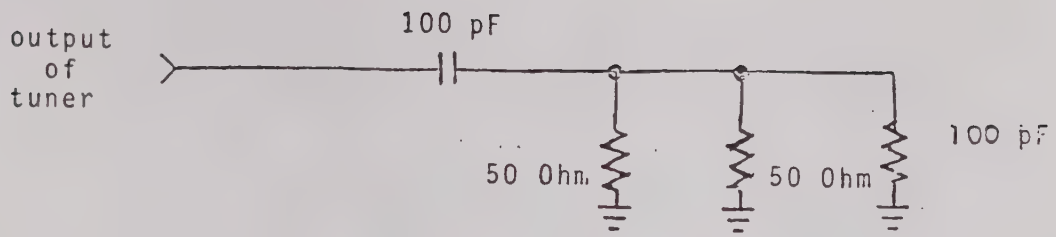


FIGURE B

5.5.31.1 Engage motors M201 and M202 to their proper positions.

5.5.32 Replace top cover.

5.5.33 Turn on R.F. Power to 500 watts if obtainable.

5.5.34 Rotate R108 clockwise for 6 watts or less reflected and 500 watts forward.

5.5.35 Turn off R.F. Power and disconnect generator.

5.5.36 Remove 117 volt AC supply from 701-702-703.

5.5.37 Disconnect simulated load.

5.5.38 Recheck mechanical connections.

5.6 Adjusting the Operating Range

The matching is achieved by virtue of two motor driven capacitors. Each of these capacitors has a limited range over which it will vary. They have been selected to accommodate the various operating parameters of a system, e.g. gas flow, pressure, R.F. Power, but differences in Reactor Chambers may require adjustment of the location or center of the range.

5.6.1 Upon installation of the unit in the system, note there is an upper variable capacitor with fixed capacitors in parallel with it, and mounted on a bracket on the variable capacitor. The location or center of the range for this variable capacitor is determined by the number of fixed capacitors on the bracket. If the range is such that the variable capacitor approaches or reaches its maximum value (fully meshed), it may be brought closer to the center or away from the maximum by adding fixed capacitance. Conversely, if the variable capacitor

5.6.1 (continued)

approaches or reaches its minimum value, it may be brought closer to the center or away from the minimum by removing fixed capacitance.

5.6.2 The upper variable capacitor is connected to the lower variable capacitor through a fixed inductor of approximately 6 turns of wound tubing. Although the inductor is fixed, its value can be adjusted by compressing the length so that the turns are closer together, or by stretching the length so that the turns become further apart. Compressing increases the inductance and stretching decreases the inductance. Adjusting the value of this inductor is the mechanism for centering the range of the lower variable capacitor. However, in order to adjust the inductor, first unfasten the top of the inductor. Refasten it after adjusting.

5.6.3 If the lower variable capacitor approaches or reaches its maximum value, it may be brought closer to its center or away from its maximum by increasing the inductance (compressing the inductor). If the lower variable capacitor approaches or reaches its minimum value, it may be brought closer to its center or away from its minimum by decreasing the inductance (stretchint the inductor). If the stretching or compressing of the inductor becomes too extreme, it may be necessary to use an inductor with a different number of turns. Increasing the number of turns increases the inductance. There are two inductors supplied with the unit in case substitution for the one installed is necessary.

5.6.4 The table below shows the operating parameters which the units are adjusted to cover at the factory. In case of retrofitting in the field, it may be necessary to readjust for the particular chamber(s) in the reactor. Simply set up each of the conditions, and for each verify that the variable capacitors are in their operating range, i.e. not at a minimum or maximum value. Correct or adjust the ranges by procedure described above.

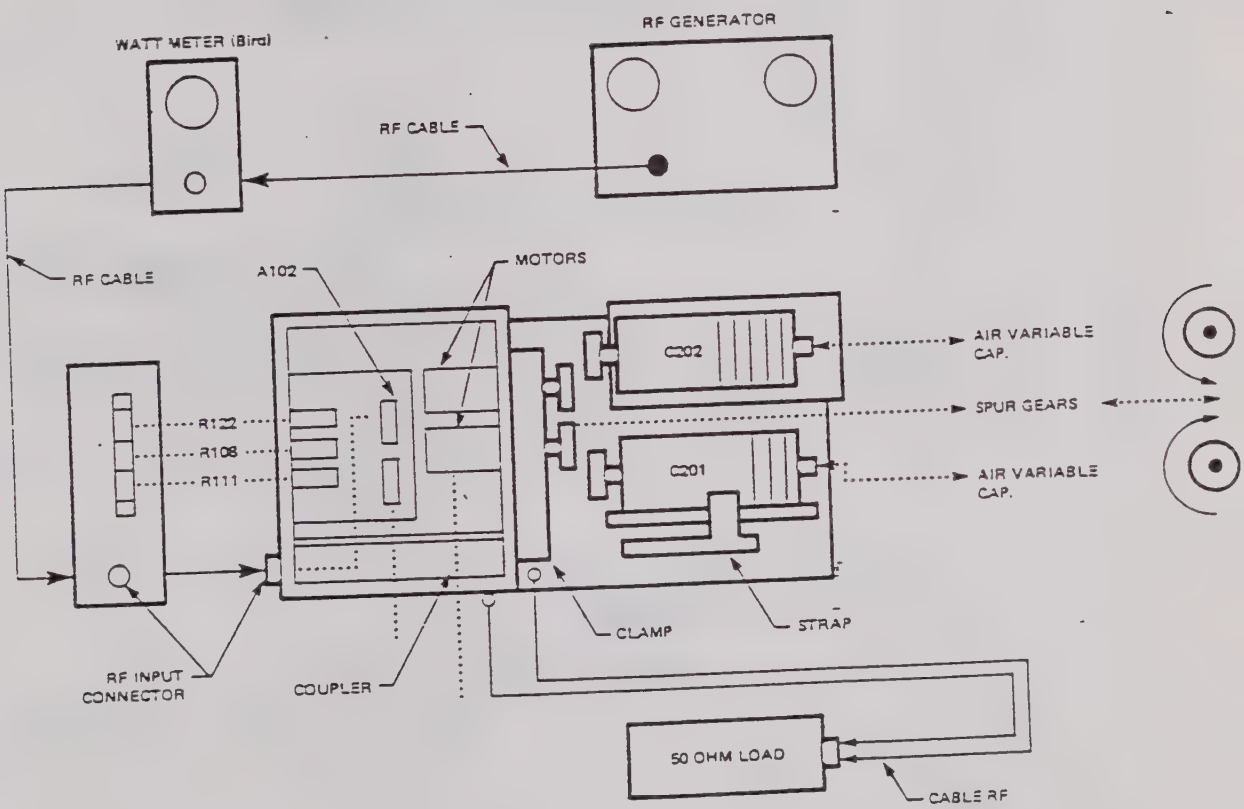
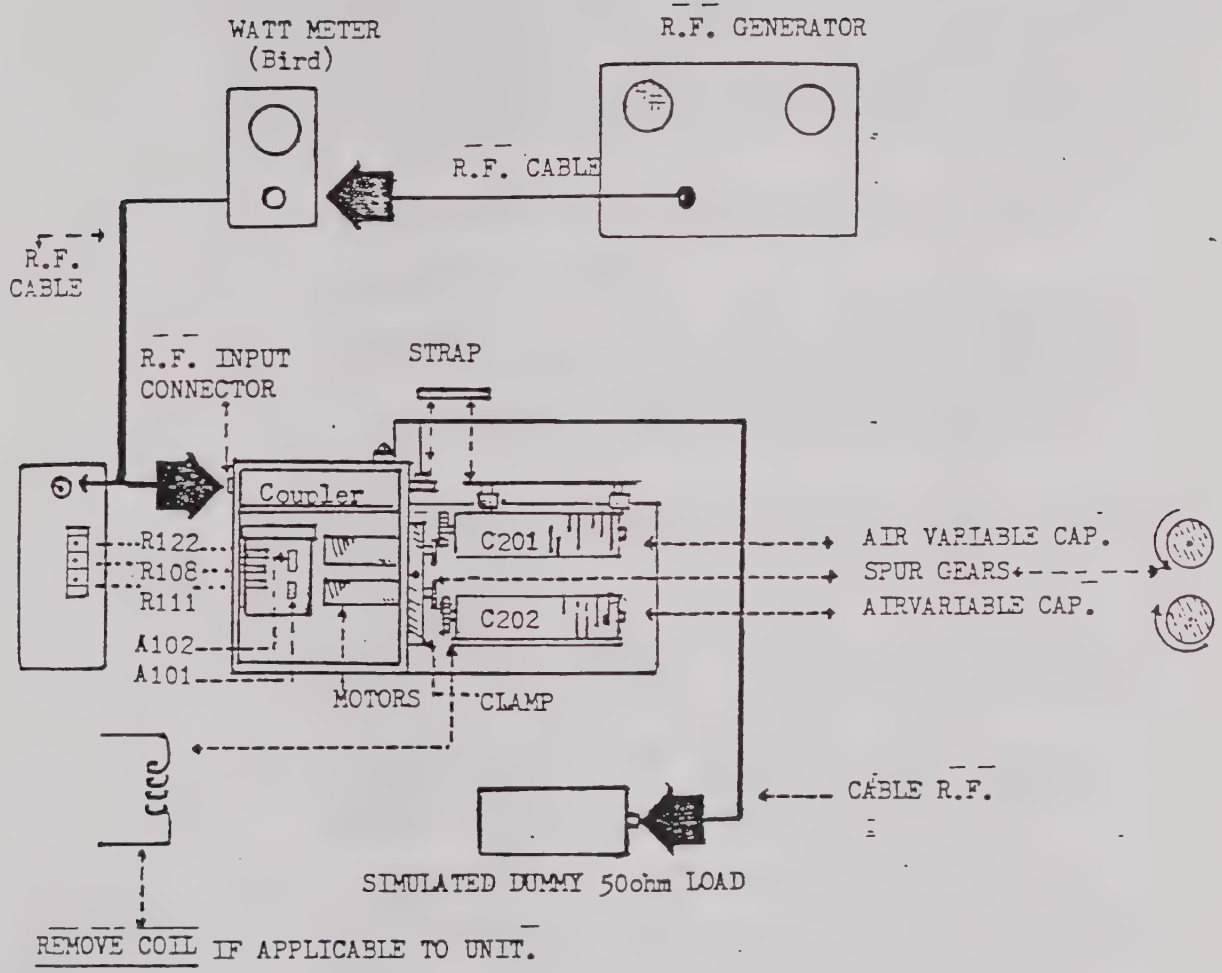


Figure 5-1. AutoMatch Mechanical Tuning Hook-Up

AUTO_MATCH MECHANICAL TUNING HOOK-UP.



REMOVE COIL IF APPLICABLE TO UNIT.

5.6 AUTOMATCH TUNING PROCEDURE

This procedure is for bench testing of the AutoMatch Control Unit. Use of a control assembly is recommended on the program cable input to the RF Generator. A Bird wattmeter is required with a 1000 watt plug and a modified coaxial RF cable is also needed for connecting the 50 ohm dummy load directly to the AutoMatch coupler output. Refer to Figure 5-1.

1. Disconnect RF strap from coupler to C201.
2. Loosen motor clamp.
3. Disengage motor gears from C201 and C202 gears by pulling motor housings back into tuner body.
4. Gently tighten motor bracket to hold motors in place.
5. Open C201 to minimum capacitance position; keep it off both limit switches.
6. Open C202 to middle position.
7. Refer to Figure 5-1 for potentiometer locations (R108, R111, and R122).
8. Connect a 50 ohm dummy load directly to coupler output - nothing else should be connected to coupler output at this time.
9. Plug AutoMatch unit into 117 volts AC supply.
10. Connect the RF Generator output to coupler input.

NOTE: DURING THE FOLLOWING STEPS; COVER THE COUPLER SIDE ONLY WITH ALUMINUM SAFETY COVER TO PREVENT ACCIDENTAL CONTACT WITH HIGH VOLTAGES PRESENT IN THE RF COUPLER SECTION.

11. Turn generator on and up to 500 watts.
12. Rotate R108 to stop M220. This will balance A101-B for a zero ouput.

Remove A102

5.6.4 (continued)

8" X 18" CHAMBER . . .

ETCHING WITH TUNNEL	0.3 TO 1.7 TORR 150 to 400 WATTS/CHAMBER
STRIPPING WITH OR WITHOUT TUNNEL	1.0 TO 3.0 TORR 300 TO 500 WATTS/CHAMBER

10" X 18" CHAMBER . . .

ETCHING WITH TUNNEL	0.3 TO 1.7 TORR 150 TO 450 WATTS/CHAMBER
STRIPPING WITH OR WITHOUT TUNNEL	1.0 TO 3.0 TORR 400 TO 700 WATTS/CHAMBER

6.0 INTRODUCTION (DPS-1000)

The optional DPS-1000, in conjunction with the system programmer, allows the operator to select one of two criteria to terminate the stripping cycle. The first is a fixed time determined by the setting of the cycle timer furnished standard with the system programmer. The second is directly related to the stripping process itself, for it is a signal based on direct detection of the stripping activity by the DPS-1000.

The DPS-1000 monitors the Reactor Chamber and measures the stripping activity. When the activity reaches a sufficiently low value, the DPS-1000 signals that fact to the system programmer. The system programmer automatically terminates the process cycle, sounding the audible alert and lighting the RESET light.

6.1 Functional Description

The DPS-1000 operates on those gaseous by-products that are generated during the stripping process. As long as photoresist remains in the chamber in presence of the oxygen plasma, these by-products will be generated. The by-products become plasma and emit light encompassing spectral energy not otherwise present. The DPS-1000 senses the presence of this spectral energy optically, utilizing the appropriate combination of photocell and optical filter.

6.1 (continued)

Fig. 1 shows a typical response of the photodetector throughout the stripping process. The initial high level transient is a result of residual air from the preceding evacuation step, as is the first of the following peaks. Following that is a true representation of the stripping activity, and it follows a curve similar to the familiar bell shape curve. From observation of the curve, the criteria for determining whether or not the stripping is complete could be either low signal level of trailing portion of the curve, or it could be the low value of the slope of the trailing portion of the curve. The DPS-1000 operates on the latter phenomena, the slope, thereby avoiding the anomolies caused by changes in off set or dc level of the curve.

However, there are several portions of the curve where the slope is low, and the DPS-1000 must ignore all but the pertinent one at the trailing end. This is accomplished by virtue of a built in time delay beginning at the start of the stripping sequence and lasting for approximately 2¼ minutes. During this time interval the detector ignores any indication of low slope and merely monitors the activity. At the end of this time interval the curve should be on its final upward slope, and the DPS-1000 stores and remembers the value of the curve at that time. As long as the activity is above that value the detector indicates stripping in progress. It is only after the curve returns to values lower than the one reached at the end of the time interval that the detector monitors the value of slope, and indicates stripping complete when the value becomes sufficiently low.

The DPS-1000 is shown functionally in Figure 2. When the system programmer initiates the stripping step by applying R.F. to the Reactor Chamber, it also starts the DPS-1000 by applying a "START TIMER" signal to it. For the first two minute fifteen second interval, the UP/DOWN COUNTER is under command of the COMPARATOR. During this interval the UP/DOWN COUNTER and DIGITAL-ANALOG CONVERTOR combination will track the amplified signal from the optical detector. The UP/DOWN COUNTER is incremented at a clock rate of four clock signals per second. Hence if the COMPARATOR indicates that the DAC output is less than the detector signal, the COUNTER will count up. If the COMPARATOR indicates that the DAC output is greater than the detector signal, the COUNTER will count down. Thus during those portions of the detector signal with positive slope, the COUNTER

6.1 (continued)

counts up; and during those portions of the detector signal with negative slope, the COUNTER counts down. The steepness of the slope will determine the rate at which the counter increments, or conversely the rate at which the counter is incremented is an indication of the steepness of the slope.

After the initial 2¼ minute interval, the counter is inhibited from counting up. At this time the detector signal should be beyond the initial transients and be somewhere on the positive going portion of the process curve. Subsequently, as long as the detector signal is greater than this value, the COMPARATOR will command UP counts, and this in turn "freezes" the system. When the detector signal returns to values below this level, the COMPARATOR commands down counts which the counter will follow. The criteria for process complete is that there must be three successive one minute intervals during which there are no more than eight down counts per interval. When this criteria has been met, the DPS-1000 indicates process complete and automatically terminates the program step.

Thus the functional block labeled "/4" (divided by 4), is a counter counting clock pulses, at the rate of two/minute. When it reaches the count of three it outputs a signal terminating the process. The "/4" counter is reset to zero if: a) there is an up count command from the COMPARATOR, b) if there are more than eight down counts during the one minute interval, and c) continuously during the initial 2¼ minute timer interval. The down counts are accumulated by the "/8" counter, which is reset to zero every one minute interval.

To recap, the sequence of events is listed below:

1. The relay in the system programmer indicates that the stripping step has started and R.F. is being applied to Reactor Chamber

2. A two minute fifteen second timer interval is started.

3. During this 2¼ minute interval the UP/DOWN COUNTER and DAC track the detector signal under command of the COMPARATOR. During this time interval the contents of the UP/DOWN COUNTER is a close digital representation of the analog signal of the detector, as the clocking rate for the UP/DOWN COUNTER is relatively high at four clocks per second. (To avoid consequences of system noise, the COMPARATOR has a built-in hysteresis of 3 DAC levels. Hence the COMPARATOR will indicate a change of direction if the DAC output deviates from the detector signal by three levels).

6.1 (continued)

4. At the end of the 2¼ minute interval the detector should be on its final positive slope.

5. The UP/DOWN COUNTER is inhibited from counting up, thereby freezing at its last value until the detector output returns to a value below this level.

6. Until the detector returns to a lower value the COMPARATOR indicates UP, thereby continuously resetting "/4". Since the "/4" never reaches the count of four it continuously indicates that the processing is in progress.

7. The detector output reaches its peak and proceeds to decrease until it reaches the value corresponding to the DAC.

8. At this time the COMPARATOR commands DOWN counts at a rate depending upon the steepness of the decline. Thus the COMPARATOR ceases to reset "/4".

9. The "/8" (Divided by 8), counts the DOWN counts. Since the rate of decline is steep, the count will reach a count of eight during the one minute intervals between resets of the "/8".

10. The "/8" resets the "/4" each time it reaches a count of eight. That is, eight down counts within the one minute interval will result in the "/4" being reset.

11. The "/4" continues to indicate that the process is in progress.

12. The slope of the detector output reaches a low level as the process nears completion.

13. The "/8" will not reach eight counts during its one minute counting interval and will cease to reset the "/4".

14. The "/4" will proceed to count at a rate of two counts per minute.

15. When the "/4" reaches a count of four it indicates to the programmer that the process is complete.

16. The programmer stops the processing, turning on the visual and audible signals.

6.2 Circuit Description

The DPS-1000 is comprised of C-MOS digital circuits and an analog amplifier/comparator circuit. The circuitry is packaged on a single printed circuit board. Refer to schematic drawing number D03200. Emitter follower regulators Q302 and Q303 are included on the P.C. Board to provide the necessary positive and negative ten volt supplies.

6.2.1 Comparator

Operational amplifier A301A amplifies the photo cell signal to a suitable amplitude for compatability with the comparator. Potentiometer R321 provides offset adjustment, and potentiometer R317 provides gain adjustment. C302 is included for dynamic stability. Comparison of the inverted and amplified photocell signal with the eight bit DAC output signal is accomplished with A301B, a high gain summing amplifier, refer to figure 3. Current into the summing node, pin 6 of A301B, depends upon the position of the analog switches internal to the DAC. ON/OFF control of these switches is determined by the digital inputs to the DAC from the UP/DOWN COUNTER. In the event that the DAC output current is less than the current into A301A pin 1, A301B output switches positive causing digital signal CU (count up) to become "true". If this occurs during the period in which the DAC is allowed to track the photocell signal, the CU signal gates 4/second clock signals to the COUNT UP input to the UP/DOWN counter through U307A. The counter continues counting up until the DAC output current is greater than or equal to the current into A301A pin 1.

Conversely, if the current into the summing node of A301B is greater than the current into A301A pin 1, A301B output switches negative CU becomes false, and CD (count down) becomes true. CD gates 4/second clock pulses to the COUNT DOWN input of the UP/DOWN counter, through U310C. The counter continues to count down until the DAC output current is less than or equal to the current into A301A pin 1.

6.2.2 Up/Down Logic

Refer to figure 5. Operation of the DPS-1000 is initiated by the enable switch.

The location of the enable switch is dependent upon the model of the system in which the DPS-1000 is installed. For IPC 2000 Series Systems, auxiliary contacts of the program 3 R.F. relay located in the PM310 module are used. In IPC 4000 Series Systems or 8000 Series Systems, an auxiliary relay located in the Reactor Center is used.

The enable switch opens to start the DPS-1000. At this time, U311 pin 4 becomes low enabling the UP/DOWN COUNTER and the timer (U301, U302, U303, U304, and U305 all use a positive signal for reset).

For the next 2¼ minutes, either count up COMPARATOR, will be gated to the UP/DOWN counter. The DAC should track the photocell signal for this period. Hysteresis is provided by R303 and R311 so that the response of the UP/DOWN COUNTER lags changes of state of the COMPARATOR.

During the 2¼ minute interval, the UP/DOWN counter is not allowed to count to a higher value that half of full scale. When the most significant bit (MSB) from the UP/DOWN counter becomes true, pin 12 of U310 becomes true through CR304. U307 pin 1 then becomes false and count up pulses are inhibited. CR304 and CR305 make up an "or" circuit. The count up pulses are inhibited by MSB from the UP/DOWN counter or by the COMPARATOR. Also, when the 2¼ minute timer input to U308 pin 2 becomes true, the latch comprised of U308A and U308B switches so that U308A pin 8 is false, U307 pin 13 is false, and count up pulses are inhibited. At the end of the initial 2¼ minute period, the UP/DOWN counter is allowed to count down only, so the DAC no longer tracks the photocell signal.

6.2.3 System Timing

Refer to figure 4. U301 is a fourteen stage ripple carry BINARY COUNTER/DIVIDER. It divides the 60/second clock signal to provide appropriate timing pulses. Pin 3 is the Q14 output which switches positive approximately 2¼ minutes after reset is removed from pin 11. Pin 15 is the Q11 output which switches positive approximately twice per minute. Pins 14, 15 and 1 are the Q10, Q11, and Q12 outputs respectively. Consequently, U307 pin 8 switches false at a rate of approximately once per minute. U302 is a four bit

AVERY

6.2.3 (continued)

BINARY COUNTER type 74C93. U302 pin 10 is the Qc output of this divide by four counter. The end of the process is determined when U302 pin 10 becomes positive. This output is used to switch Q301. Q301 in turn provides the signal which will cause the enable switch to close and disable the DPS-1000 at the end of the process. When pin 3, 4, or 5 of U307 becomes low, pin 6 becomes high and resets U302 so that END OF PROCESS signal can not become high. Pin 5 of U307 resets U302 whenever count up ENABLE from the COMPARATOR becomes true. Pin 3 of U307 resets U302 continually during the initial 2¼ minute interval. Pin 4 of U307 resets U302 whenever the output of U303, the divide by 8 counter becomes high. U303 is also a 74C93 BINARY COUNTER. It is reset every 1 minute interval by the output of U307A at pin 8 and it is held reset during the initial 2¼ minute interval when U308 pin 4 becomes low.

After the initial 2¼ minute interval, U303 Qd output will continually reset U302 and prevent END OF PROCESS until the rate of the count down pulses into U302 pin 8 becomes less that 8 per minute for the period required for U302 to count to four.

6.3 Alignment Procedure

The DPS-1000 has two adjustments only: (1) Amplifier offset and (2) Amplifier gain. These variable resistor adjustments are accessible through a vertical slot in the rear panel of the Reactor Center. There are five resistors and the ones of concern are the bottom two. The second resistor from the bottom is R317, the gain adjustment. The bottom resistor is R321, the offset adjustment.

6.3.1 Equipment Required

If a chart recorder has not been provided with the system, a high impedance meter or an oscilloscope will be necessary to monitor the DPS-1000 amplifier output. In systems which do not include chart recorder, the amplifier output has been brought out to the rear of the Reactor Chamber to a five pin connector or a terminal strip labeled "Chart Recorder".

6.3.2 Offset Adjustment

Following is a step by step procedure for adjusting the amplifier offset:

1. Evacuate the chamber(s) to a vacuum of 2 torr.
2. Do not turn on R.F.
3. Monitoring the amplifier output with chart recorder, adjust the bottom resistor so that amplifier output voltage is at zero volts.

6.3.3 Gain Adjustment

Following is a step by step procedure for adjusting the amplifier gain:

1. Adjust the second resistor from the bottom fully counter clockwise.
2. Using oxygen gas, at a pressure of 2 torr, turn on the R.F. and adjust the power to 300 watts.
3. Adjust second resistor from bottom until chart recorder reads 0.25.

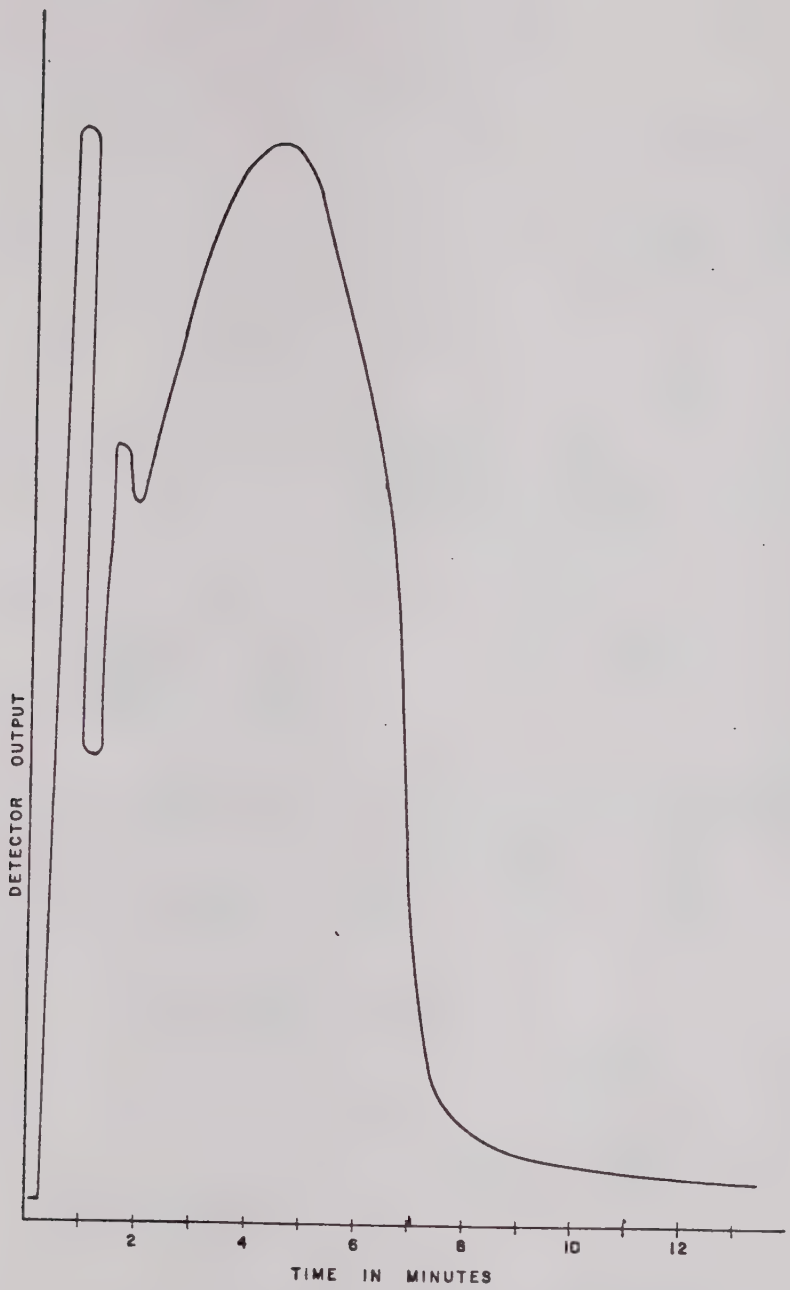


FIG. 1

B 03294 REV.

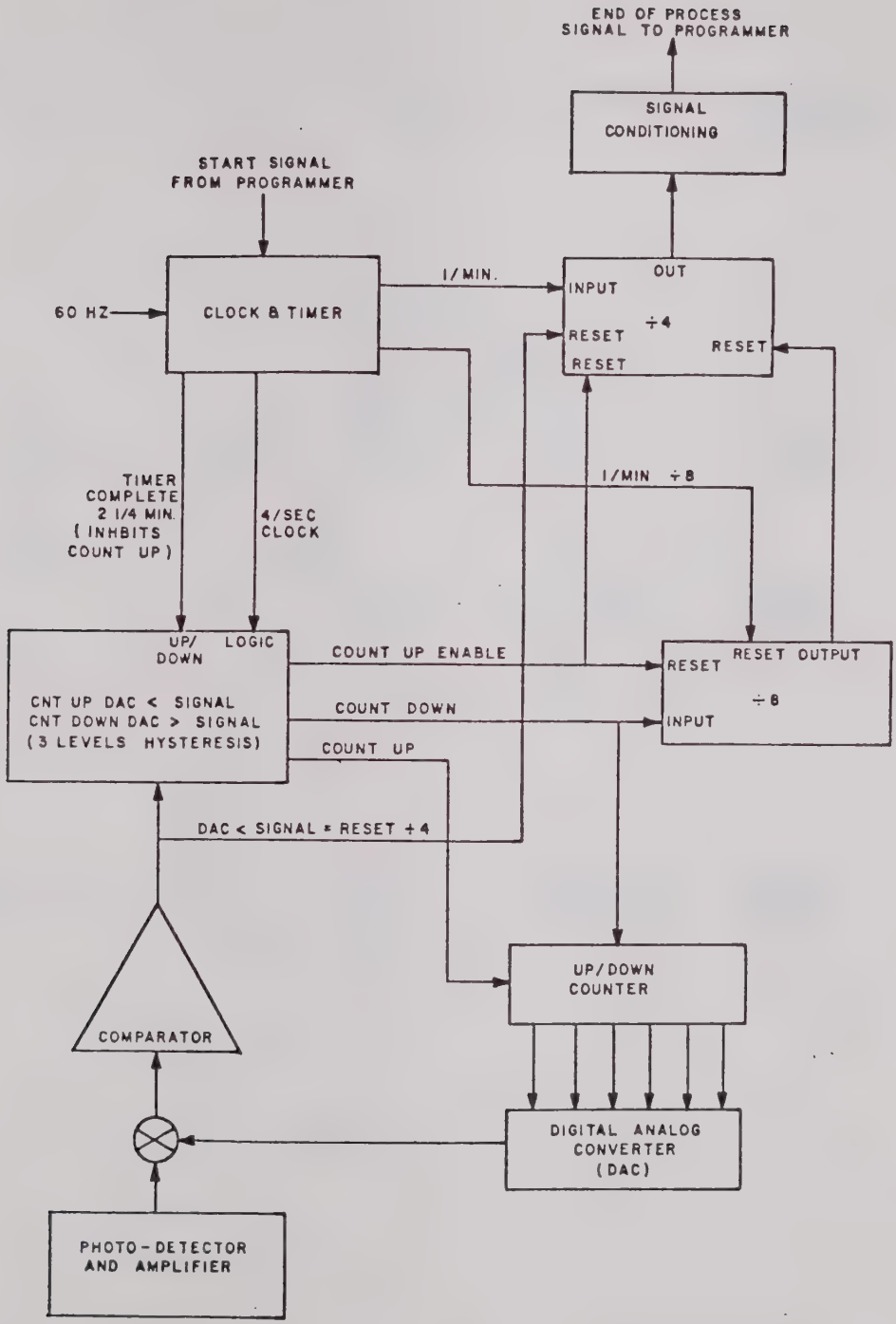


FIG. 2

DPC-1000 PROCESS DETECTOR
FUNCTIONAL BLOCK DIAGRAM

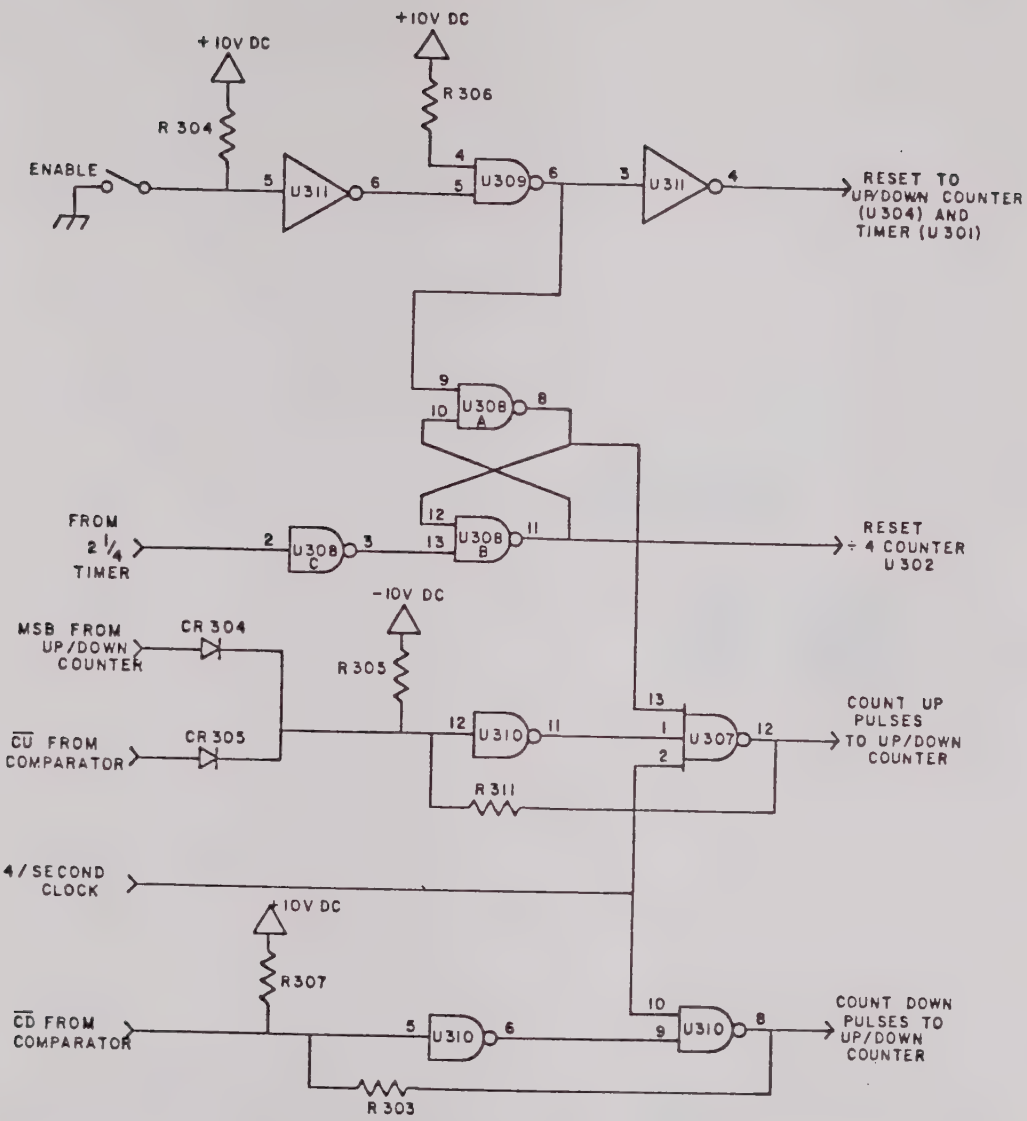
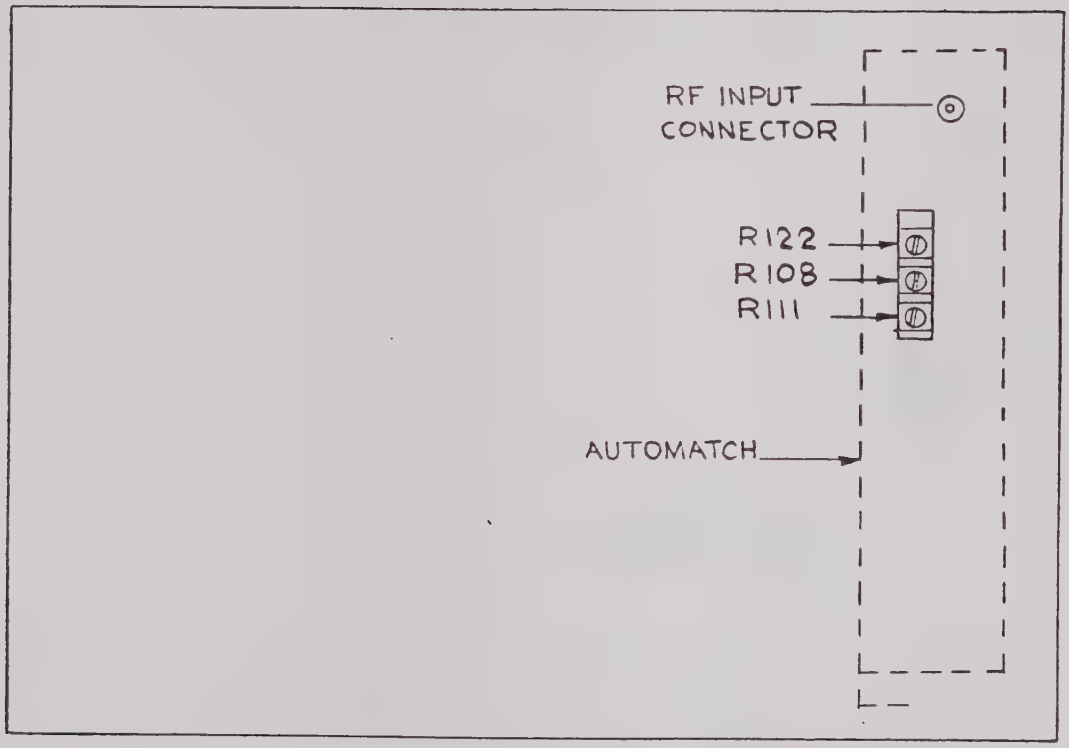
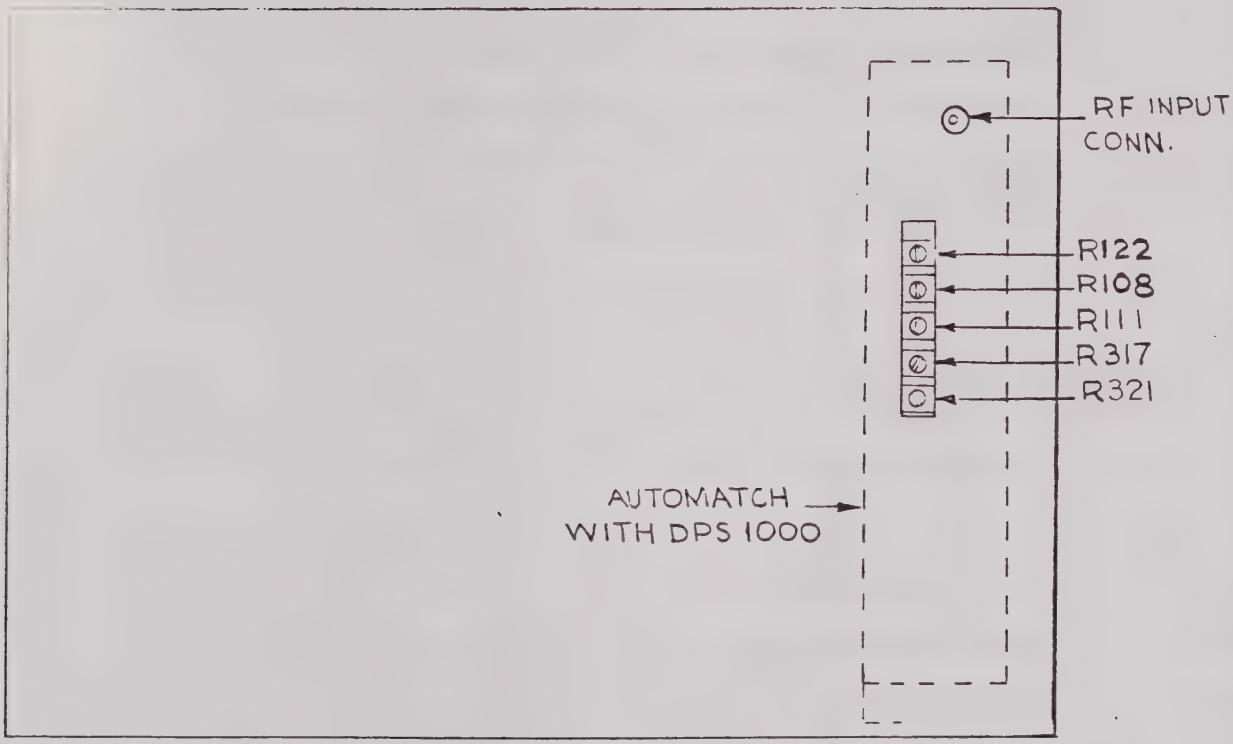

+10V DC
+10V DC
R 306
R 304
ENABLE
U311
U309
U311
RESET TO UP/DOWN COUNTER (U304) AND TIMER (U301)
U308 A
FROM 2 1/4 TIMER
U308 C
U308 B
RESET ÷ 4 COUNTER U302
-10V DC
MSB FROM UP/DOWN COUNTER
CR 304
R 305
CU FROM COMPARATOR
CR 305
U310
U307
COUNT UP PULSES TO UP/DOWN COUNTER
R 311
4/SECOND CLOCK
+10V DC
R 307
CD FROM COMPARATOR
U310
U310
COUNT DOWN PULSES TO UP/DOWN COUNTER
R 303

FIG. 5



REACTOR CENTER
REAR VIEW

FIGURE 6
LOCATION OF ADJUSTMENT
POTENTIOMETERS



REACTOR CENTER
REAR VIEW

FIGURE 7
LOCATION OF ADJUSTMENT
POTENTIOMETERS

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	RF CONDUCTOR	B 02821	1
C203	CAPACITOR 8.2 F	1500-0222	1
	SPRAGUE 5GA-V8Z		
C210,	CAPACITOR 100 p F	1500-0117	2
209	CM 05-ED-K1J03		
CR201-	DIODE	4800-0045	3
203	MOTORALO IN4151		
L202,	COIL 39 μ H	1800-0012	2
203	J W MILLER 9210-56		
1	LOCKING TERMINAL LUG		8
	H H SMITH 1416-8		
2	RING TERMINAL - NON INSULATED		6
	12-10 AWG HH SMITH 4934		
3	SCREW		4
	8-32 UNF-2A × 3/4 BHMS NYLON		
4	NYLON SPACER-RND		6
	.250D× .125 LG-H H SMITH 4008		
5	NYLON SPACER-RND .250D×.187LG		3
	H H SMITH 4005		

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TITLE: RF CONDUCTOR SUB ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	02827	E	EHS 8-7-78	JV

DRAWN	DATE	SHEET
JV	7-5-78	2 OF 3

ENGINEERING PARTS LIST

0

REF. NO.	DESCRIPTION	PART NO.	QTY.
10	WASHER		
	#8 FLATWASHER STL.		
7	NUT		
	8-32 UNF-2B HEX KEPS NUT		
8	WIRE		A/R
	12 GA BUSS WIRE		
9	WIRE		A/R
	16 GA BUSS WIRE		

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TITLE: RF CONDUCTOR SUB ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	02827	E	RHS 8-78	

DRAWN	DATE	SHEET 3 OF 3
JV	7-5-78	

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
C1	AIR VARIABLE CAP	1550-0201	1
	EF JOHNSON 154-513-101		
1	STL EXSPANSION PIN .062 DIA x .50 DP	2860-9001	1
	Mc MASTER-CARR 98296A109		
2	STL EXPANSION PIN .093 DIA x .750 DP	2860-9003	1
	Mc MASTER-CARR 98296A181		
3	GEAR MODIFICATION	B04564	1
4	INTERCONNECTION BRKT	B 03533	2

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TITLE: PM 702 & 703
C1 - INPUT CAPACITOR
ASSY

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	03470	C	RHS 8-8	PCG

DRAWN	DATE	SHEET 2 OF 2
JV	7-7-78	

A 04289 REV B

ENGINEERING PARTS LIST O

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	MOTOR	3500-0005	1
	MICRO MO 3301409-03-Z-1734:1		
2	CLUTCH	3500-0015	1
	STERLING SLIPCLUTCH #MM-2		
3	STL EXPANSION PIN .062 DIA x .50 LG	2860-9001	1
	Mc MASTER-CARR #98296A109		
4	GEAR ALUM	3500-0023	1
	STERLING S21A-54		

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TITLE: M1 INPUT MOTOR DRIVE ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
B	03471	B	8-7B	

DRAWN	DATE	SHEET
JV	6-28-78	2 OF 2

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
C2	AIR VARIABLE CAP	1550-0202	1
	EF JOHNSON 154-510		
1	STL EXPANSION PIN .062 DIA x .50 DP	2860-9001	1
	McMASTER-CARR 98296A109		
2	STL EXPANSION PIN .093 DIA x .75 DP	2860-9003	1
	McMASTER-CARR 98296A181		
3	INTERCONNECT BRKT	B 03533	2
4	GEAR MODIFICATION	B 04564	1
	REVISED CONFIGURATION		

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TITLE: P/N 702
C2- OUTPUT CAPACITOR ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	04440	B	RHS 8-7-78	

DRAWN	DATE	SHEET
JY	7-7-78	2 OF 2

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	MOTOR	3500-0004	1
	MICRO MO 33D/409-03-2-975: 1		
2	CLUTCH	3500-0015	1
	STERLING SLIPCLUTCH * MM-2		
3	STL EXPANSION PIN .062 DIA x .50DP	2860-9001	1
	MC MASTER-CARR 98296A-109		
4	GEAR ALUM	3500-0023	1
	STEARLING 521A-54		
	KEYWAY E02471-002		

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TITLE: M Z OUTPUT MOTOR DRIVE ASSY

SIZE	DWG. NO.	REV.	CHK.	APPR.
B	04416	A	B.S & T.E.	P.G.

DRAWN	DATE	SHEET
JV	6-28-78	2 OF 2

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	LIMIT SWITCH STOP BRK'T	03064	2
2	RF CONDUCTOR STRAP, LOWER	B02825	1
3			
4	RF CONDUCTOR SUPPORT PLATE	B02820	1
5	MOTOR CRADLE	B02819	1
6	HOUSING COVER	C02818	1
7	HOUSING, RF PARTITION	C02817	1
8	HOUSING, REAR ANGLE	C02816	1
9	HOUSING, FRONT ANGLE	C02815	1
10			
11	BASE PLATE	D04482	1
12	INPUT CAPACITOR BRK'T	B03212	1
13	BASE PLATE MTG BRK'T	B02814	1
14	RF CONDUCTOR COUPLER	B04427	1
15	INPUT CAPACITOR BRK'T	B04396	1
16	MOTOR CAP	B04452	1
17	2" CERAMIC STANDOFF	3100-0142	1
	H.H. SMITH #135-503		
18			
19	HEX THD STANDOFF, 6-32 x .25 LG.		1
	H.H. SMITH #8421		
20	HEX THD STANDOFF, 8-32 x .25 LG.		2
	H.H. SMITH #2325		
21	SCREW, 10-32 UNF-2A x 1.50 LG. BHMS STL.		1

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TITLE AUTOMATCH ASS'Y - W/DPS-1000
PM 702

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04491	A	D.Yeh	TVD

DRAWN	DATE	SHEET
S.Sisek	8-17-78	2 OF 5

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
22	SCREW, 8-32 UNC-2A x 1.25 SHCS STL		2
23	SCREW, 6-32 UNC-2A x .187 BHMS BRASS		11
24	SCREW, 10-32 UNF-2A x .375 BHMS BRASS		1
25	NUT, 6-32 UNC-2B BRASS HEX		4
26			
27	LOCKING TERMINAL LUG		1
	H.H. SMITH #1416-8		
28	SCREW, 8-32 UNC-2A x .187 BHMS NYLON		1
29	LOCKING TERMINAL LUG		5
	H.H. SMITH #1416-6		
30	CABLE		A/R
	BELDEN #8777		
31	WASHER, #8 NYLON, FLAT		2
32	RF COUPLER ASS'Y	C 02827	1
33	PHOTO DETECTOR ASS'Y	B 03324	1
34	BRAID SHIELD, 7/32		A/R
	BELDEN #8863		
E1-7	INSULATED TERMINAL	2160-0207	7
	USECO #1417-9		
C4-8, 10-14	CAPACITOR, FEED THRU 1000 PF	1500-0205	7
	ERIE #327-005-X5U0-102M		
C3,9	CAPACITOR, 2000 μF 24 V	1500-0203	2
	SPRAGUE #TVA-1213		

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TITLE AUTOMATCH ASS'Y - W/DPS 1000 PM 702

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04491	A	P.YEH	

DRAWN	DATE	SHEET 3 OF 5
SSlosek	8-17-78	

A 04289 REV B

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
C1-12	TRANSMITTING CAP 100pF 5KV	1500-0189	2
	CENTRALAB #850S-100N		
CR5-8	DIODE	4800-0013	4
	MOTOROLA #1N4007		
CR4,9	DIODE	4800-0045	2
	MOTOROLA #1N4151		
CR3	DIODE BRIDGE	4800-0044	1
	INTERNATIONAL RECTIFIER #1B0B2A		
R1-2	RESISTOR, C.C. 100Ω, 2W, 5%	4705-0101	2
S1-4	SWITCH - SPDT, MOMENTARY-ON	5100-0154	4
	C&K #7109 L2DZBE		
T1	TRANSFORMER	5600-0006	1
	SIGNAL #241-4-20		
L1	INDUCTOR, 6½ TURNS	B 02824	A/R
	7½	B 04455	
	8½	B 04456	
	9½	B 04457	
	10½	B 04458	
	11½	B 04459	
	2½	B 04460	
	3½	B 04461	
	4½	B 04462	
L1	INDUCTOR, 5½ TURNS	B 04463	A/R

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TITLE AUTOMATCH ASS'Y - W/DPS 1000 PM 702

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04491	A	D.YEH	YCC

DRAWN	DATE	SHEET 4 OF 5
SSlocek	8-17-78	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
J1	RF CONNECTOR	2180-0190	1
	AMPHENOL #83-798		
P1	CONNECTOR, 7 PIN, MALE	2152-1607	1
	AMPHENOL #MS-3102-10S-1P		
P2	EDGE CONNECTOR, 22 PIN	2100-0223	1
	VECTOR #R644		
A1	CIRCUIT BOARD ASS'Y	C04486	1
M1	INPUT MOTOR ASS'Y	B03471	1
M2	OUTPUT MOTOR ASS'Y	B04416	1
C1	INPUT CAPACITOR ASS'Y	C03470	1
C2	OUTPUT CAPACITOR ASS'Y	C04440	1
	MANUAL		REF
	SCHEMATIC	D04495	REF

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TITLE: AUTOMATCH ASS'Y - W/DPS 1000 PM 702

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	04491	A	D.Y.G.H	P.C.S

DRAWN	DATE	SHEET
S Sosek	8-17-78	SHEET 5 OF 5

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
	PRINT CIRCUIT BOARD	03201	1
7	HEAT SINK	B 04485	7
C101	CAPACITOR .01 F 500V	1500-0001	3
102, 301	SPRAGUE 5GA-510		
C302	CAPACITOR .1uF 20V	1500-0026	1
	SPRAGUE UK20-104		
1	DIP SOCKET 14 PIN	2110-0001	9
	AMPH 821-20011-144		
2	DIP SOCKET 16 PIN	2110-0002	4
	AMPH 821-20011-164		
3	DIP SOCKET 8 PIN	2110-0015	1
	AUGAT 508-AG10D		
R314, 315	RESISTOR CARBON	4702-0102	3
R121	1K 1/4W		
R124,	RESISTOR CARBON	4702-0103	4
125	10K 1/4W		
R101,	RESISTOR CARBON	4702-0153	2
102	15K 1/4W		
R116	RESISTOR CARBON	4702-0154	2
117	150K 1/4W		
R302-	RESISTOR CARBON	4702-0223	9
310	22K 1/4W		
R316, 320	RESISTOR CARBON	4702-0275	2
	2.7 MEG 1/4W		

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TITLE: PM 702 AUTOMATCH
W/DPS-1000 BOARD ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	04486	C	PE	

DRAWN	DATE	SHEET 2 OF 5
K.G.	5/8/79	

A 04288 REV

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
R318	RESISTOR CARBON	4702-0394	1
	390K 1/4W		
R109	RESISTOR CARBON	4702-0472	3
301, 110	4.7K 1/4W		
R312	RESISTOR CARBON	4702-0473	3
319, 123	47K 1/4W		
R313	RESISTOR CARBON	4702-0512	1
	5.1K 1/4W		
R107	RESISTOR CARBON	4703-0050	2
115	5.1Ω 1/2W		
R118,	RESISTOR CARBON	4702-0562	2
119	5.6K 1/4W		
R122	POTENTIOMETER 20K	4750-0010	1
	BOURNES 3069P-1-203		
R317	POTENTIOMETER 20K	4750-0010	1
	BOURNES 3069P-1-203		
R108	POTENTIOMETER 10K	4750-0013	3
111, R321	BOURNES 3069P-1-103		
A101	OPERATIONAL AMPLIFIER	4800-0012	2
102	FAIRCHILD 747		
CR302	DIODE	4800-0038	2
303	ZENER IN4740A 10V		
CR101,102	DIODE	4800-0045	4
304, CR305	MOTOROLA IN4151		

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TITLE
PM 702 AUTOMATCH
W/DPS-1000 BOARD ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	04486	C	PB	

DRAWN	DATE	SHEET 3 OF 5
K.G.	5/8/79	

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
Q102,104	TRANSISTOR PNP	4800-0046	3
303	MOTOROLA 2N4918		
Q101,103	TRANSISTOR NPN	4800-0047	4
301,302	MOTOROLA 2N4921		
A301	OPERATIONAL AMPLIFIER	4800-0130	1
	NATIONAL LM 358		
U301	COUNTER/DIVIDER	4800-0131	1
	BINARY 14 STAGE		
	NATIONAL CD 4020C		
U302, 303	COUNTER 4 BIT BINARY	4800-0132	2
	NATIONAL MM 74C93		
U304, 305	COUNTER 4 BIT BINARY	4800-0133	2
	UP/ DOWN		
	NATIONAL 74C 193		
U306	DAC 8 BIT	4800-0134	1
	ANALOG DEVICE AD 7530		
U307	NAND GATE TRIPLE 3 INPUT	4800-0135	1
	NATIONAL MM 74C10		
U308	NAND GATE QUAD 2 INPUT	4800-0136	3
-310	NATIONAL MM 74C00		
U311	HEX INVERTER	4800-0137	1
	NATIONAL MM 74C04		
CR301	DIODE	4800-0138	1
	ZENER IN5237B 8.2V		

DIONEX
GAS PLASMA DIVISION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE: PM 702 AUTOMATCH
W/ DPS-1000 BOARD ASSEMBLY

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	04486	C	TB	

DRAWN	DATE	SHEET 4 OF 5
K.G.	5/8/79	

A 04288 REV

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
R120, 311	RESISTOR CARBON	4702-0474	2
	470K 1/4W		
4	SCREW		7
	4-40 UNF-2A X .375 BHMS, STL.		
5	NUT		7
	4-40 KEPNUT, STL.		
6	WASHER		7
	#4 FLAT FIBER WASHER		

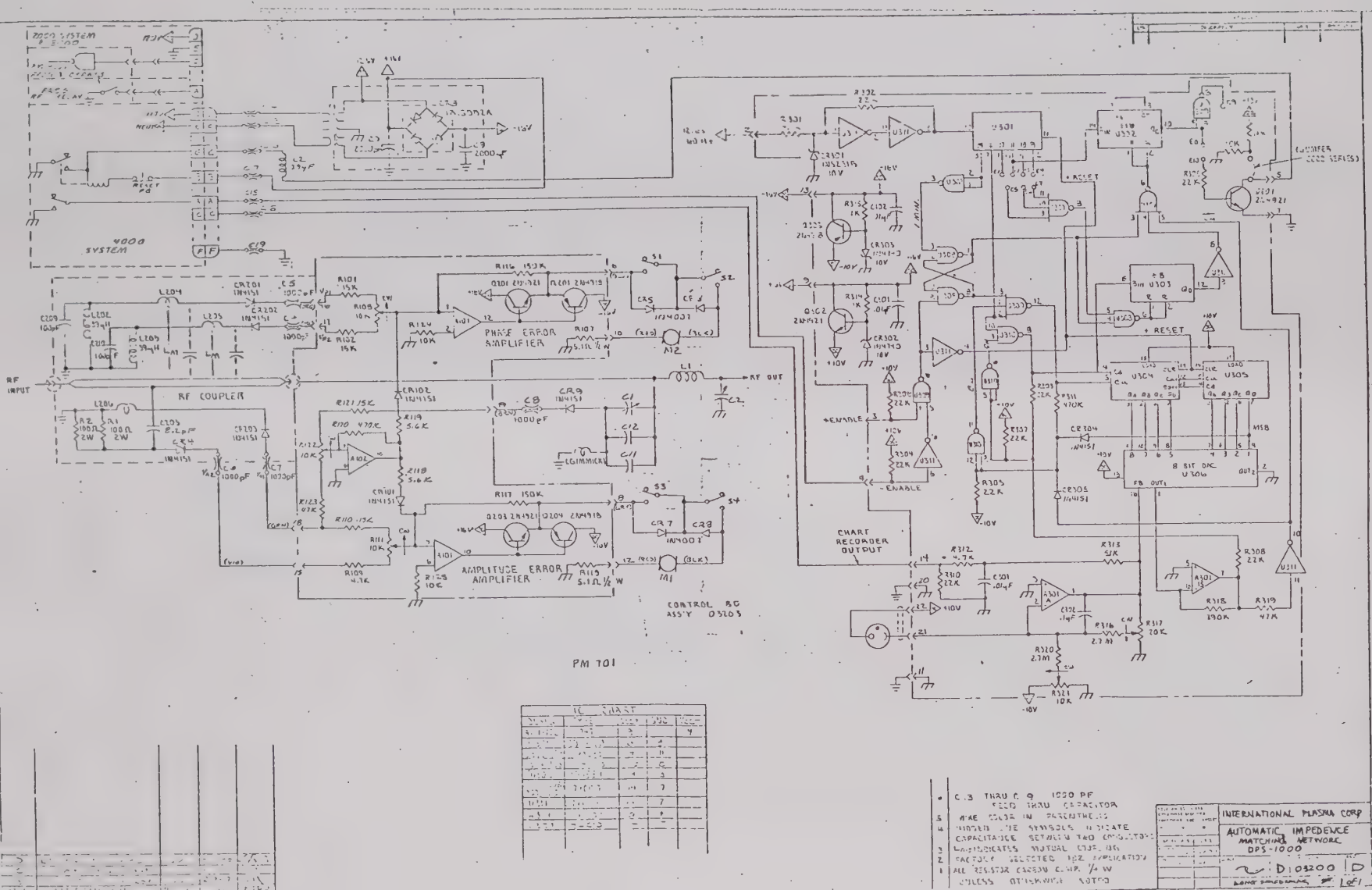
DIONEX
GAS PLASMA DIVISION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE: PM 702 AUTOMATCH
W/DPS-1000 BOARD ASSEMBLY

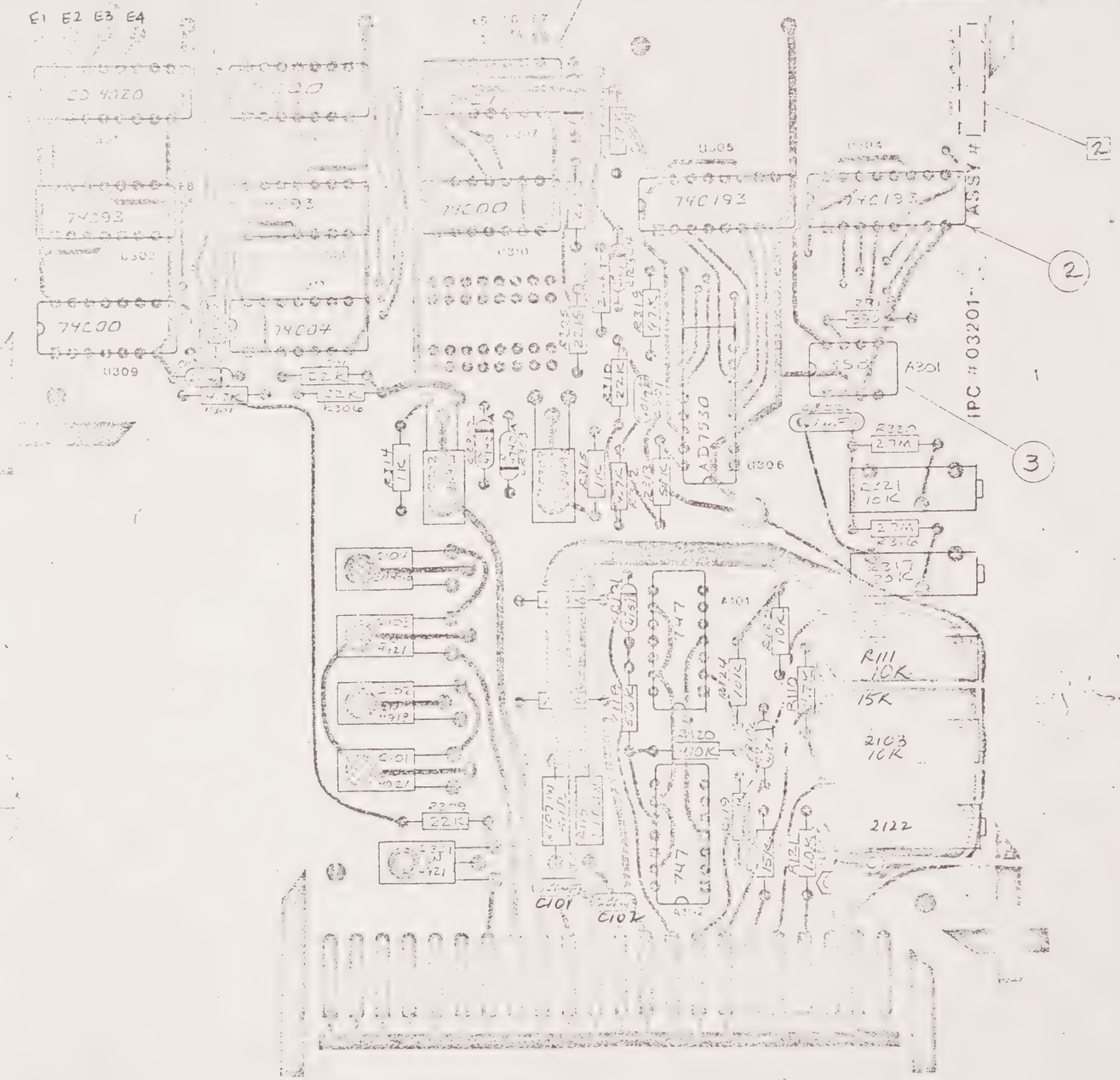
SIZE	DWG. NO.	REV.	CHK.	APPR.
C	04486	C	PB	

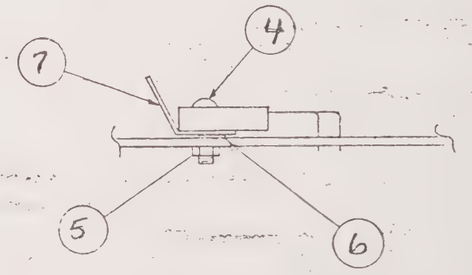
DRAWN	DATE	SHEET 5 OF 5
K.G.	5/8/79	

A 04288 REV


4000 SYSTEM
RF COUPLER
RF INPUT
RF OUT
PHASE ERROR AMPLIFIER
AMPLITUDE ERROR AMPLIFIER
CONTROL BD ASS'Y 03203
CHART RECORDER OUTPUT
8 BIT DAC U306
PM 701
INTERNATIONAL PLASMA CORP
AUTOMATIC IMPEDENCE MATCHING NETWORK DPS-1000
D03200 D

REV	DESCRIPTION	DATE	APPROVED
A	ECO # 10543		
B	ECO #10543		
C	ECO 10543		





TRANSISTOR MOUNTING DETAIL

2	STAMP ASSY NO. 04484	
1	ALL RESISTOR 1/4 W CARBON 5% UNLESS OTHERWISE SPECIFIED	

INTERNATIONAL [illegible] CORP.
AUTOMATIC WIRE [illegible]
BD. ASSY PIC 752

SCALE	SIZE	DRAWING	REV
2X	C	04484	C

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

2100 SYSTEM
4000 SYSTEM
120V
117V
NEUT
RF RELAY
RESET P.B
P1
T1
CR3 1N1580B2A
C3 2000μF
C9 2000μF
-16V
12.6V
+16V
L2 37μH
C13
C14
C15
C16
C17
C18
C19

RF INPUT
L204
CR201 1N4151
CR202 1N4151
L202 39μH
L203 39μH
L203 LM
C209 100pF
C210 100pF
C5 100pF (ORG)
C4 100pF (YEL)
R101 15K
R108 10K
R102 15K
VP1
VP2
CW
R124 10K
Q101 2N4921
Q102 2N4918
R116 150K
A101
PHASE ERROR AMPLIFIER
R107 5.1Ω ½W
M2
S1
S2
CR5 1N4007
CR6
(BLU)
(RED)
(BLK)
L1
RF OUT
C2
C8 1000pF
CR9 1N4151
C1
C12
C11
(GIMMICK)
L204
R2 100Ω 2W
R1 100Ω 1W
C203 82pF
CR203 1N4151
CR4 1N4151
C6 1000pF
C7 1000pF
VA2
VA1
R121 9.1K
R120 470K
R122 10K
R119 5.6K
R118 5.6K
A102
CR102 1N4151
CR101 1N4151
R123 47K
R110 4.7K
R111 10K
R109 4.7K
R125 10K
R117 150K
Q103 2N4921
Q104 2N4918
R115 5.1Ω ½W
AMPLITUDE ERROR AMPLIFIER
M1
S3
S4
CR7 1N4007
CR8
(GRY)
(BLK)
(VIO)
(GRN)
P2
1
5
19
8
12
10
6
7

CONTROL BD ASS'Y #04486

IC CHART				
DESIG	TYPE NO	Vcc+	GND	KEY
A101-102	747	9		1
U301	CD 4020	16	8	
U302-303	74393	4	11	
U304 305	74393	16	8	
U306	AD7530	14	3	
U307 308	74C00	14	7	
309, 310				
U311	74C04	14	7	
A301	LM358	3	4	
U302	74C20	4	7	

PM 702

R302 22K
R301 4.7K
R301 1N5231B 5.1V
12.6V 60 HZ
U311
U301
U302 ÷N
+16
+10V
U309
10K
R309 22K
U301 2N 4921
(JUMPER 2000 SERIES)
+ RESET
U308
U307
U303 ÷8
R315 1K
C102 .01μF
Q302 2N-3138
CR303 1N4740 10V
R314 1K
C101 .01μF
Q302 2N4921
CR302 1N4740 10V
U310
U304 CLR Cnt Borr
U305 LOAD CLR Cnt Cd
MSB
R306 22K
R304 22K
R303 22K
R307 22K
R311 470K
R305 22K
CR304 1N4151
CR305 1N4151
8 BIT DAC U306
FB OUT1
OUT2
P2
+ENABLE
(-ENABLE)
CHART RECORDER OUTPUT
R312 4.7K
R310 22K
C301 .01μF
R313 5.1K
R308 22K
A301
C302 .1μF
R316 2.7M
R317 20K
R318 390K
R319 47K
R320 2.7M
R321 10K
CW
CCW

6	C13 THRU C19: 1000 PF FEED THRU CAPACITOR			
5	WIRE COLOR IN PARENTHESIS			
4	HIDDEN LINES SYMBOLS INDICATE CAPACITANCE BETWEEN TWO CONDUCTO			
3	L# INDICATES MUTUAL COUPLING			
2	FACTORY SLECTED FOR APPLICATION			
1	ALL RESISTORS CARBON COMPOSITION ¼ W UNLESS OTHERWISE NOTED			
B	E.O. 10845	KC/PE	11-13-78	
A	E.O. 10345 ADDED CR305	KC/PE	7-27-78	
ECN	ORIGINAL RELEASE	KC	DATE	ADD'D

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
± ± ±

APPROVALS	DATE
DRAWN	
CHECKED	

INTERNATIONAL PLASMA CORP
AUTOMATIC IMPEDENCE MATCHING NETWORK W/ DPS-1000
SCALE 2
SIZE D
DRAWING NO. 04495
REV B
DO NOT SCALE DRAWING
SHEET 1 OF 2

BRANSON/IPC
a SmithKline company

BRANSON INTERNATIONAL PLASMA CORPORATION

INSTRUCTION MANUAL

for

R. F. GENERATOR PM 119

2/1/78

31172 Huntwood Avenue
P.O. Box 4136, Hayward, CA 94544
(415) 489-3030 Telex: 337-759

INSTRUCTION MANUAL

for

PM 119

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1.0 INTRODUCTION

1.1 General Description:

The PM119 RF Generator provides the necessary radio frequency power to generate a plasma in either the 8000 series or 2000 series plasma systems. It includes circuits which measure characteristics of the plasma in the reaction chamber, with provisions to drive meters remotely located in the system controller.

The metered quanitities are the RF (radio frenquency) power level transmitted to the chamber; the reflected power, indicating any impedance mismatch between the chamber impedance and 50 ohms; and the pressure of the gas in the chamber.

The output power level is continously controlled over the full 500 watt range by a remote knob. The output level is regulated to withstand normal line voltage variations about 117 volts at either 50 or 60 hertz.

The frequency of the output is crystal controlled at 13.56 Megahertz. The output is designed to drive a 50 ohm load.

The PM119 also includes provisions for initiating the process cycle in an 8000 series controller. It detects that the reaction chamber has been evacuated to a preset level (aproximately 0.2 torr) and transmits a signal to the controller which then begins the process cycle.

1.2 Specifications:

Output Frequency.....	13.56 Mhz ±0.005%, crystal controlled
Output Power.....	0-500 watts with continous control
Output.....	Designed for 50 ohm load
Output Connector.....	Type UHF
Power Monitor.....	Output DC current is provided to drive an external meter which is calibrated to a full scale

1.2 (con't)

Power Monitor (con't).....reading of 500 watts. Two seperate outputs give the power transmitted to or reflected from the load.

Vacuum Monitor.....A calibrated DC current is provided to drive a remote meter which is scaled from 0.1 to 20 with a shaded region to indicate atmospheric pressure. The signal drive to the meter is brought in from outside the PM119, being generated by a vacuum transducer in the treatment console.

Power Control.....A remote rotary control knob continously varies power from zero to maximum. A remote toggle switch may switch the RF output on or off. A front panel AC line switch turns power of the PM119 on or off.

WARNING! WHEN OPERATING THE AC POWER SWITCH FROM ON TO OFF, THE OUTPUT POWER MUST BE AT A MINIMUM. EITHER THE LEVEL CONTROL MUST BE AT A MINIMUM SETTING, OR THE RF ON/OFF SWITCH MUST BE OFF.

Rear Panel Connections.....A permanently attached three-wire power cord is provided at the rear panel. A rear connector provides A.C. Power, metering signals, interlock wires, and control wires to the system programmer. A second connector provides power to and receives the signal from the vacuum transducer. A third connector provides RF output.

Power Requirements.....117 volt nominal AC, 50-60 Hz, 15 Amp, maximum. Requires normal three-wire input with ground, neutral and 117 volt leads.

Dimensions.....Width 21 inches
.....Height 11 inches
.....Depth 16.5 inches

Weight.....75 lbs.

1.3 Equipment Supplied:

The following equipment is supplied with the PM119 Control Console:

1 RF Power Output Cable IPC# 01163-001
1 Programmer Cable IPC# 02351-001
1 Vacuum Transducer Cable IPC# 02492-001

2.0 INSTALLATION:

2.1 Unpacking and Handling:

The IPC PM119 Control Consoles are thoroughly tested and inspected and then carefully packed before shipment. The unit should be unpacked with the care due any precision instrument. If the package shows that it has been dropped or handled roughly, return it to the carrier unopened.

Remove the packing carton, being careful not to scar or damage the unit. Make a complete visual inspection of the equipment, checking for damage or missing components. Check that all switches and controls operate mechanically. Report any damage immediately to your IPC representative.

2.2 Installation:

No special installation instructions are required for the PM119 other than those required if special peripheral equipment is required. Mount it as close as possible to the RF power load and leave clear space at the back of the instrument to allow air flow. The PM119 is attached to the RF load with the supplied RF power output cable. If the PM119 is used in a standard IPC Plasma Generation System, Vacuum Transducer and Programmer cables may be used directly. Their connections will be explained in the manual for the system. Connections to other equipment must be taken up as special cases. Information must be obtained from a IPC representative or from reference to the schematic.

BE SURE TO REMOVE SHORTING WIRES ON METERS IN GENERATOR BEFORE OPERATION!

3.0 OPERATION:

3.1 Controls and Indicators:

The operating controls and indicators of the PM119 are located on the front panel. The connectors are

3.1 (con't)

on the rear panel. In the text, all operating controls are called out as they appear on the equipment. Front panel controls and rear panel connectors are described in the following table:

Front Panel Controls and Indicators

AC POWER ON/OFF Switch.....Applies AC power to the PM119

WARNING! WHEN OPERATING THE AC POWER SWITCH FROM ON TO OFF, THE OUTPUT POWER MUST BE AT A MINIMUM. EITHER THE REMOTE LEVEL CONTROL MUST BE AT A MINIMUM SETTING, OR THE REMOTE RF ON/OFF SWITCH MUST BE OFF.

AC POWER Indicator.....The lamp above the AC POWER switch lights when the AC POWER is ON.

READY Indicator.....The lamp lights when RF power is available. Approximately 3 minutes after the AC POWER has been turned on.

Rear Panel Connectors

AC Power Cord.....A permanently attached three-wire cord through which the PM119 obtains its line power.

VACUUM TRANSDUCER Connector.....Allows the vacuum transducer which drives the vacuum meter to be attached to the PM119. It supplies power to the transducer and couples the return signal to the meter.

PROGRAMMER Plug.....This connects the PM119 to the remote controls which normally determine the PM119 output. 117 VAC is sent to the remote unit. A control line to an external potentiometer determines the PM119 output power level. Three sets of meter leads drive an external vacuum meter and forward and reflected power meter. A power interlock lead may be used to interrupt R.F. power from the PM119. An output denoting a preset vacuum level is provided.

3.1 (con't)

RF POWER OUTPUT.....Connects PM119 output power to Connector the load via UHF type connector.

3.2 Operation:

Instructions in this section apply to operation of the PM119 independently as a source of RF power. Operation in complete IPC Plasma Systems is described in the manual which applies to that particular machine. Sufficient instructions are included here to operate the PM119 as a power source to supply energy into a 50 ohm matched load.

Since power from the PM119 is controlled via the Programmer cable, either appropriate auxiliary equipment must be provided which includes the RF control or a special control must be constructed. This may be simply a 100K, 2W potentiometer connected to pins L, J, and K of the PROGRAMMER jack. Fasten the wiper to pin J and the end of the pot contacted by the wiper in full clockwise rotation to pin K.

Operating Procedure

1. Attach the RF power output cable to the power output connector on the rear panel of the PM119 and couple the 50 ohm load to the other end of the cable.

2. When the PM119 is used in a complete IPC plasma system, the Programmer cable and Vacuum Transducer cables are installed. As it is here being used separately, install the special RF control discussed above. No RF power can be obtained without some connection to the Programmer jack.

3. Set the AC and RF POWER switches to OFF, the RF POWER LEVEL control full counterclockwise, and the FWD/REFL switch to FWD.

4. Plug the three-wire power cord into the appropriate power outlet socket.

5. Allow the PM119 to warm up 3 minutes with the AC POWER switch ON before operating any other controls. If the PM 119 is used in a complete IPC PLASMA machine evacuate the Reaction Chamber to a pressure of 2 torr.

6. After the unit is warmed up, the READY indicator will light. Turn the RF POWER switch to ON.

7. Raise the RF LEVEL control until RF output is obtained If the PM 119 is used in an IPC PLASMA System, the power may be read on the wattmeter provided in the system. If it is used separately, an external inline

3.2 (con't)

7. (con't) wattmeter must be provided between generator and load.

8. Rotate the RF POWER LEVEL control clockwise until the wattmeter reading moves up the scale.

9. With the wattmeter reading about 50 watts, change the FWD/REFL switch to REFL. With a matched 50 ohm load, this reading should be very small. If it is large, more than 10-15 watts, then the load must be matched to bring the reflected power down. If the PM119 is used in a standard IPC Plasma System further instructions on matching will be contained in the manual for that system. If not, other means must be used to bring the load to a matched condition.

10. When the load is matched, the power may be raised to any value up to maximum. Return the FWD/REFL control until the wattmeter reads the desired power output.

11. Check the reflected power by switching the FWD/REFL switch to REFL, to be sure that the load remains matched. Reflected power should be less than 2.0% of the forward power. Power must be reduced <u>if the match</u> is not maintained.

WARNING: WHEN OPERATING THE AC POWER SWITCH FROM ON TO OFF, THE OUTPUT POWER MUST BE AT A MINIMUM. EITHER THE LEVEL CONTROL MUST BE AT A MINIMUM SETTING, OR THE RF ON/OFF SWITCH MUST BE OFF.

4.0 THEORY OF OPERATION

4.1 Functional Description:

A functional block diagtam of the PM119 is shown in Fig.1. The OSCILLATOR, POWER AMPLIFIER, COUPLER and REGULATOR constitute a feedback control system regulating the output power at a level determined by the RF level control located on the front panel of the PM119 Generator. The OSCILLATOR generates a 13.56 mhz sine wave which is amplified by the POWER AMPLIFIER. The amplitude of the OSCILLATOR'S output is controlled by the REGULATOR. The COUPLER detects the power supplied by the POWER AMPLIFIER and outputs a dc signal proportional to the power. This dc signal is fed to the REGULATOR where it is compared with the setting of the remote power level setting.

The POWER AMPLIFIER is designed to drive a resistive fifty ohm load, and the reactor center input circuitry is designed to present a fifty ohm load to the generator. This

4.1 (continued)

constitutes a "matched' modular system. In order to provide the appropriate fifty ohm impedance each Reactor Center includes a "matching network" which transforms the impedance of the plasma chamber to fifty ohms. This network must be adjusted to accomodate each set of operating parameters of the Reactor Chamber, e.g; power, pressure, gas. The adjustment of the matching network may be either manual or automatic, depending upon the option provided in the Reactor Center. However, during the time that the matching network is being adjusted, a mismatched condition exists which is a potential hazard to the output stage of the POWER AMPLIFIER. To prevent possible damage to the generator, the COUPLER detects the degree of "mismatch" and provides a DC signal proportional to the mismatch. This signal is referred to as "reflected power", and is fed to the REGULATOR. If the reflected power exceeds a preset limit, the REGULATOR automatically limits the output power to a level that is safe.

The VACUUM CIRCUIT provides the power required by the vacuum sensor in the Reactor Center, and provides the appropriate interface between the sensor and the vacuum display or mater. The VACUUM TRIGGER detects a preset vacuum level and transmits a signal to the Reactor Center (8000 Series). The 5 torr detector circuit disables RF when a pressure greater than 5 torr is detected in the Reaction Chamber. Operating the system at greater pressure may result in damage to the Reactor Center "matching network". The power supply generates the DC voltages required by the system.

4.2 Circuit Description: Refer to Schematic D03035

4.2.1 Power Amplifier:

The power amplifier utilizes a single vacuum tube tetrode V1, which is connected in a common cathode configuration. Capacitors C6 and C7 with inductors L1 and L2 constitute a two section filter to attenuate the RF to the high voltage power supply. Capacitors C14, C15, and C16 provide AC ground to the screen grid of the power tube. C17 is an RF bypass for the filament. An RF voltage is fed to the control grid from the oscillator, and the resulting amplified plate signal is coupled to a pi matching network through C13. The RF signal and the superimposed DC bias fed to the grid of the power amplifier bear the proper relationship and the amplitude to drive the amplifier class C

The pi matching network transforms the load impedance

4.2.1 (con't)

normally fifty ohms, to a higher impedance appropriate for the plate circuit of the tetrode. It is composed of capacitors C9, 10, 11, 12, 18, and 19 with inductor L3. The output of the pi filter is shunted by inductor L4, which serves as a bleeder and filter to power supply ripple frequencies. The variable inductor L3 is the means for adjusting or tuning the plate circuit to the oscillator frequency, while variable capacitor C12 provides means for adjusting the efficiency of the power amplifier class C stage.

Variable capacitor C17 is a neutralizing capacitor, and feeds back a small fraction of the RF plate voltage to the oscillator output circuitry. There it is added out of phase with the oscillator signal to effect the neutralization.

Resistor R112 is a voltage dropping resistor for the screen, and voltage across it serves as a measure of the screen current. Fuse F1 limits the screen current to a safe value. The fuse is readily accessible on the front panel.\

4.2.2 Coupler

The RF Coupler receives the signal from the power amplifier, and with minimal loss couples it to the output cable. It also generates dc signals represtative of the power coupled to the output and of the impedance mismatch between the actual load and the desired 50 ohms. These two dc signals are fed to the regulator.

4.2.3 Oscillator

The oscillator is a single stage tuned plate-tuned grid vacuum tube oscillator. The frequency controlling element is a 13.56 mhz crystal, X301 in the grid circuit. R301 provides a dc path for the control grid current, as the grid bias is class C. The plate tuned circuit is comprised of inductor/transformer L303 and capacitors C305, C306m and C307. Variable capacitor C306 provides the means for adjusting the frequency of the plate circuit to crystal frequency. L303 also serves as an autotransformer which transforms the impedance of the power amplifier grid circuit to a higher impedance appropriate for the plate of the oscillator tube. Also L303 with resistors R304 and R305 complete the path for neutralizing the power amplifier tube. R310 and C311 comprise an

4.2.3 (con't)

attenuator and phase shift network completing the feedback loop for the oscillator. C308 provides ac ground for the plate circuit. R302 with bypass capacitor C301 provide a means for monitoring the oscillator tube current at TB2-1 through an isolation resistor R303. The 450 volt plate supply is fed to the plate through L302. L302 and C312 filter the RF to the supply.

The amplitude of the OSCILLATOR output is determined by the positive dc voltage on the screen grid of the oscillator tube. This control voltage is supplied to the OSCILLATOR at terminal E303 by the REGULATOR. A resistive load and voltage supply for the REGULATOR output is provided by the resistor divider R309, R306, R307, R308, and R6. The resistor string is connected between +250 volts at the top and -250 volts at the bottom. The divider also offsets the dc voltage provided by the REGULATOR to bias the control grid of the POWER AMPLIFIER. Transistor Q301 buffers the bias voltage and supplies it to the POWER AMPLIFIER through a filter, L304 and C309, and through L303. Diode CR301 prevents the bias voltage from going too far in the positive direction thereby protecting the POWER AMPLIFIER tube. Capacitors C302 and C303 provide RF bypassing for the screen grid of the OSCILLATOR.

4.2.4 Regulator

The REGULATOR performs two functions. It monitors the power level through the coupler and controls its level according to the setting of the remote RF LEVEL control. It also monitors the "reflected power" from the COUPLER, and if it exceeds a preset level the REGULATOR automatically limits the drive to the POWER AMPLIFIER to a safe level.

Referring again to the schematic, the power level controller consists of operational amplifier A201, buffer transistor Q201, and associated circuitry. The dc signal from the COUPLER is fed through LC filter L201 and C201. This filtered voltage drives the wattmeter through R203. Rheostat R2 serves to calibrate the meter for "forward power". R205 provides a load for the coupler output in the absence of a meter.

The dc gain of the control loop is provided in two parts: The integrated amplifier A201 which

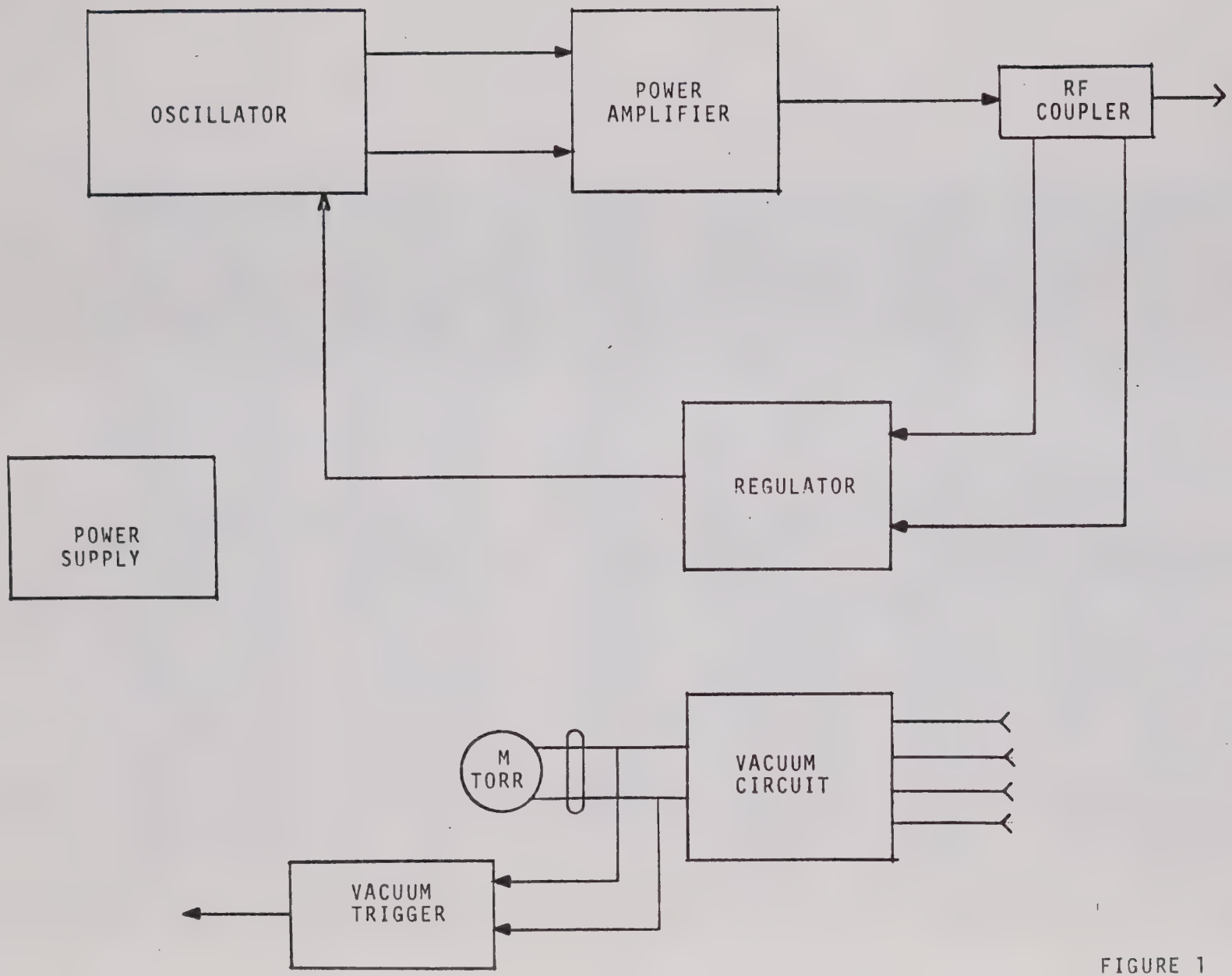
OSCILLATOR
POWER AMPLIFIER
RF COUPLER
REGULATOR
POWER SUPPLY
M TORR
VACUUM CIRCUIT
VACUUM TRIGGER

FIGURE 1

has a gain in the order of 10^6: and the amplifier comprised of transistor Q201 and resistors R211 and R213, with a gain of 22. The entire amplifier is made an integrator with feedback capacitor C207 and input resistors R201, R220, R217 and R1. The reference voltage for the amplifier is signal ground through R207. Operationally the regulator output provides a positive voltage to the oscillator grid causing an RF signal through the coupler such that the positive polarity "forward power" signal exactly balances the negative voltage set up by the remote RF LEVEL control.

Capacitors C203, C211 and C209 insure dynamic stability for the feedback amplifier. The output of the integrated amplifier is prevented from going more negative than -5 volts by a clamping network comprised of CR204, CR201, and R209.

The amplifier comprised of integrated amplifier A201 and Q202, with their associated circuitry, perform the identical function as described above, except that it deals with the "reflected power" from the coupler. Its output is combined with the output of the forward power amplifier so that either can limit the RF power output.

If the magnitude of the "reflected power, a positive voltage, exceeds the magnitude of the negative voltage, set by R218, the amplifier shuts down the oscillator by decreasing the oscillator screen voltage.

4.2.5 Vacuum Circuit

The vacuum transducer, which is located in the reactor center remote to the generator, is a thermocouple type. It requires a power source to power its heaters and a meter to display the voltage of its thermocouple. The power source is located in the generator, while the meter is located in the system programmer.

The transducer power source is the vacuum circuit oscillator comprised of integrated circuit amplifier A401 and surrounding components. R401, R402, R403, C402, and C403. The oscillator generates a square wave at approximately one kilohertz. The amplitude of the square wave is adjusted with R4 and coupled to the transducer through transformer T401. The transducers thermocouple is then applied to the remote meter.

4.2.6 Vacuum Trigger

Some plasma system controllers, e.g. 8000 series, require the detection of a preset vacuum level. In the PM 119 this level is preset by R5. The signal is detected by the DC amplifier comprised of integrated circuit amplifier A401, transistor Q401, and their associated circuitry.

The voltage of the transducer thermocouple is applied to one input terminal of the amplifier and the voltage determined by R5 to the other. If the voltage of the thermocouple exceeds the potentiometer voltage, indicating that the chamber pressure is below the preset level, transistor Q401 is turned off. The voltage divider of the R10 and R407 with the +250 volt supply provide the appropriate drive for the relay located in the reactor controller.

4.2.7 5 Torr Detector Circuit

If the PM 119 is used with a complete IPC PLASMA machine, the 5 torr detector circuit inhibits RF when Reactor Chamber pressure is greater than 5 torr. Otherwise excessively high voltages occur in the Reactor Center "matching network" which could damage the network. The vacuum level signal is detected by the DC amplifier comprised of the integrated circuit amplifier A402, transistor Q402, and their associated circuitry. The voltage of the vacuum transducer thermocouple is applied to one input terminal of the amplifier, and the voltage determined by R414 to the other. If the voltage of the thermocouple is less than the potentiometer voltage, Q402 is turned ON. The screen grid of V101, the oscillator tube, is then shunted to ground and RF is inhibited.

4.2.8 Power Supply

The power source for the PM 119 is nominally 117 volts at 50-60 Hz. Referring to the schematic, S1 switches the input power and also provides overload protection. DS1 is the lamp indicating that power is being applied to the unit. B1 is the blower which provides positive air cooling. Transformer T1 provides all the necessary AC voltages utilized in the power supply. Winding S2 drives the filament of the power amplifier tube directly, and winding S4 drives the filament of the oscillator tube. Winding S1 provides the high voltage AC for the power amplifier plate supply. Its output is received by the diode

4.2.8 (continued)

bridge made up of the 20 diodes (five per leg) CR105-CR124. Capacitor C5 is a filter reducing the 100-120 Hz. ripple, and resistors R117-R121 provide a bleeder path for the supply. Winding S3 of T1 provides the AC voltage for generation of all other DC supplies. The negative 250 volt supply is developed by the full wave rectifier/filter comprised of CR126, CR125, and C2. R116 is a bleeder path for the supply. Similarly the positive 250 volt supply is developed by the full wave rectifier/filter comprised of CR102, CR104, and C1. R115 is the bleeder resistor.

The positive 450 volt supply is generated by a voltage doubler arrangement wherein the 250 volt supply is supplemented by a rectifier/filter CR103, C103, CR101, and C104. The bleeder resistor is R114. The two 12 volt supplies consist of zener diodes CR1 and CR2 with resistors R7 and R8. The positive 250 volts is applied to the system through the contacts of time delay relay K1, providing approximately three minutes for the filaments of the power tube to heat before it is called upon to deliver RF. DS1 is a front panel lamp indicating that the warm-up time is over. R13 is a current limiting resistor for the lamp. The output of the plus 250 volt supply is also fused by F1 to prevent overheating of the power amplifier screen grid. If the fuse chould open, it also removes the 250 volts from the screen grid of the oscillator and thereby turns off the oscillator.

5.0 MAINTENANCE

5.1 Packaging

The PM 119 is partitioned into three parts as follows:

1) A lower partition, which becomes accessible upon removal of the bottom cover.
2) A front partition, which becomes accessible upon removal of the hood and front portion of the top cover.
3) A rear partition, which becomes accessible upon removal of the hood and rear portion of the top cover.

All those adjustable components involved in alignment of the generator are included in the lower partition. Each adjustable component is accessible through an access hole in the front or rear panel, or by removing the bottom cover. The lower partition includes two circuit boards. The first contains the circuitry of the RF OSCILLATOR and is bolted directly to the chassis. All of the oscillator parts, except the vacuum tube, are mounted on the

bottom side of the circuit board. The vacuum tube is accessible by removing the top rear cover.

The second circuit board is a plug-in board which houses the circuitry of the REGULATOR, the VACUUM CIRCUIT, and the VACUUM TRIGGER. Adjustments on this circuit board include the FORWARD POWER LIMIT and the REFLECTED POWER LIMIT. They are accesable through an access hole in the rear panel.

The front partition houses the several power resistors, R7, R8, R10, R11, and R12; the power supply filter capacitors C1 and C2; and the front panel parts.

The rear partition includes the circuitry for the RF POWER AMPLIFIER and the voltage supplies. The rectifier diodes with filter capacitors C103 and C104 are packaged on a circuit board which is mounted on top of the power supply transformer T1.

All connectors for mating with other system components are located on the rear panel.

For precise location of parts refer to drawing D03100.

5.2 Preventive Maintenance

The most obvious requirement for preventive maintenance is cleansing the air filters mounted on the rear panel. They are aluminum mesh and can be cleaned with ordinary solvents. If they are not cleaned , restricted air flow could result in damage to the power amplifier tube. The cooling fan requires no lubrication.

5.3 Alignment

As stated previously, all adjustable components are accesible through the front and rear panels, or by removing the bottom partition, it is most convenient to set the generator on the side nearest the ac power ON/OFF switch.

As discussed in Section 3.2, the PM119 is controlled via the PROGRAMMER cable. Consequently, the controls necessary to perform the following adjustments must be provided in the manner indicated in Section 3.2. The PM119 may either be installed in a system, such as an IPC 2000 series system, which includes the necessary control circuits, or a special control must be provided.

5.3 (con't)

Make certain the AC power switch is OFF and the AC power cord disconnected. Remove the botton cover.

Disconnect the 6 volt filament drive [orange wire) by disconnecting the insulated slip-connector in the 6 volt line adjacent to the oscillator board.

Make the following initial adjustments:

1) Bias level (R6) - Mid position.
2) Oscillator tuning capacitor (C306) - Mid position.
3) Plate tuning Capacitor (C12) - Mid position.
4) Plate coil (L3) - fully out, then in three complete turns.
5) Forward limit (R217) - Full counter clockwise.
6) Reflected limit (R218) - Full Counter clockwise.
7) Neutralizing capacitor (C17) - Fully out, then in two full turns.

Turn the RF POWER LEVEL control to its minimum (fully counter clockwise) position.

Set the RF POWER ON/OFF switch to its OFF position.

Plug in the A.C. Power cord.

Turn the A.C. power switch on.

Wait approximately three minutes at which time the READY light will turn on.

Set the R.F. POWER ON/OFF switch to its ON position.

Observe the output of the generator at the RF connector with an oscilloscope. If an oscilloscope is not available, a detector and dc meter may be used.

Observe the voltage on TB2-1 and slowly turn the RF LEVEL control clockwise for a voltage of 4.0 to 5.0 volts. (level control will be sensitive since the circuit is operating open loop without feedback from the RF coupler).

Adjust the oscillator plate tuning capacitor, C306, for a minimum voltage on TB2-1.

Connect a dc voltmeter, e.g. Simpson 260, from TB2-2 to ground. The voltage to be measured here represents the power amplifier plate current, and will be about 0.4 volts.

Connect a dc voltmeter from TB2-1 to ground. The voltage to be measured here represents the oscillator tube cathode current, and will be about 4.6 volts.

Observing the output of the generator, adjust the neutralizing capacitor C17 for a voltage null at the output.
Return the POWER LEVEL control to its minimum position.
Turn OFF the RF ON/OFF switch.

5.3 (con't)

Turn OFF the A.C. POWER switch.

Reconnect the filament lead slip-connector.

If the system wattmeter has not been calibrated, insert an in line wattmeter, e.g. a Thruline Model 43 wattmeter from Bird Electronic Corporation with a 500 watt plug, between the generator RF output connector and a 50 ohm dummy load. The dummy load should be rated for a continous drive of 1000 watts.

Put the A.C. POWER switch to its ON position. After the READY light comes on, turn on the RF ON/OFF switch. Adjust the POWER LEVEL-- control for about 150 watts at the output. Observe the voltage at TB2-2, and adjust L3 for a minimum.

Increase the setting of the POWER LEVEL control for an output power level of 500 watts.

Observe the voltage on TB2-2. Adjust L3 for a minimum and note the minimum value. Adjust C12 so that the minimum value is negative 0.4 volts.

Observe the voltage on TB2-1. Adjust C306 for a null and note the null value. Adjust R6 for a of 4.6 volts.

5.4 Calibration (Do not perform calibration unless 5.3 has been done).

5.4.1 Power Meter

Calibration of the system power meter requires a reference meter, e.g. the Thruline Model 43, and a 50 ohm load. If a dummy 50 ohm load is not available, it is feasable to use a reactor center properly matched. An IPC reactor center with AutoMatch would suffice. Using a clip lead, ground J3 pin 8 of the regulator printed circuit board. Insert the reference meter between the generator and the dummy load. Place the FWD/REFL switch in its FWD position, the RF LEVEL OFF and the AC POWER ON. Adjust the mechanical zero of the front panel power meter to read zero (0).

Turn the FWD LIMIT (located on the plug in the circuit board) potentiometer to its extreme counterclockwise position. With the POWER LEVEL control completely counterclockwise turn the POWER LEVEL switch ON.

Slowly advance the POWER LEVEL control to extreme clockwise position. The output power should remain at zero. Adjust the FWD LIMIT potentiometer until the reference meter reads 500 watts.

Turn the POWER LEVEL control counterclockwise until the reference meter reads 500 watts. Adjust R2, FWD CAL, so that the front panel meter also reads 500 watts.

Adjust the RF LEVEL control for zero (0) watts and turn the RF OFF. Disconnect the RF cable from the generator output connector. Turn the REFL LIMIT potentiometer to its extreme counterclockwise position.

Turn the RF LEVEL ON, and turn the LEVEL control slowly to its maximum clockwise position. The RF output should remain at zero (0). Adjust the REFL LIMIT potentiometer until the meter reads 50 watts. Put the FWD/REFL switch to its REFL position. Adjust the REFL CAL potentiometer until the meter reads 50 watts on the "reflected power" scale. Remove the clip lead from J3 pin 8.

5.4.2 Torrmeter

The torrmeter adjustment is one which must be made in conjunction with the vacuum transducer which is to be used with the torrmeter. The transducer is normally located remotely in a unit external to the generator. In addition to the system transducer, another reference transducer/meter combination is needed on the same vacuum system. There also must be a means for adjusting the vacuum in the system.

If these conditions can be met, set the system pressure (utilizing air) to 0.2 torr according to the reference torrmeter/transducer. Adjust the VAC CAL potentiometer so that the front panel meter also reads 0.2 torr. Adjust the mechanical adjustment on the front panel meter so that it also reads 2.0 torr. Repeat the process until no further adjustments are necessary.

5.4.3 Vacuum Trigger

To set the VAC level, set the system pressure to 0.2 torr and observe the voltage at pin 7 of J3. J3 is the printed circuit board connector. The voltage will be either zero (0) volts or approximately +125 volts. Set the VAC TRIG adjustment so that this voltage just changes from its zero to its positive level. Allow the system pressure to rise above 0.5 torr (or until the voltage returns to its zero level). Reduce the pressure and verify that the voltage returns to its positive level at 0.2 torr. Reajust VAC TRIG as necessary.

5.4.4 5 Torr Detector

To set the 5 torr level, set the system pressure to 5.0 torr and observe A402 pin 12 of the regulator PC board. The voltage will be either +12VDC or -12VDC. Adjust R414 until the voltage just switches to +12VDC. Reduce the pressure and verify that the voltage switches to -12VDC.

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	HIGH VOLTAGE BOARD	C030531	1
C104	CAPACITOR 100 mfd 350V DC	1500-0214	1
	SPRAGUE 39D-107F350HS4		
C103	CAPACITOR 20 mfd 450V DC	1500-0215	1
	SPRAGUE 39D-206F450GL4		
E101-103, 106-108, E111	TERMINAL	2860-2008	7
	H.H. SMITH #2008B		
R114-116	RESISTOR CARBON 100K 2W	4705-0104	3
R117-121	" " " " 200K 2W	4705-0204	5
R113	" " " " 1Ω 5W	4706-0010	1
	SPRAGUE #243E1R05		
CR101-126	DIODE	4800-0008	26
	MOTOROLA #MR510		

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TITLE: HIGH VOLTAGE BOARD ASS'Y
PM118-119

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	03053	B	10-16-78 SV	

DRAWN	DATE	SHEET
S.S.	7-13-78	SHEET 2 OF 2

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
	OSCILLATOR BOARD	C 03039	1
2	FIBER WASHERS		2
	#6 x 1/16" THICK		
3	SOCKET TUBE, 9 PIN	2110-0306	1
	(SAE #5-9388)		
4	CRYSTAL SOCKET	2110-0053	1
	CINCH JONES # 2JKC		
C303, 308	CAPACITOR CERAMIC DISK 1 KV .01 μF	1500-0003	2
	SPRAGUE #5GA-S10		
C302, C304 C310	CAPACITOR CERAMIC DISK 1 KV .001 μF	1500-0032	3
	SPRAGUE #5GA-D10		
C309	CAPACITOR MICA 39 pf	1500-0051	1
C301	CAPACITOR CERAMIC DISK 1KV 2200 pf	1500-0212	1
	SPRAGUE #5GA-D22		
C307	CAPACITOR CERAMIC DISK 1KV 47 pf	1500-0217	1
	SPRAGUE #5GA-Q47		
C311	CAPACITOR, DIPPED MICA 500V 200 pf	1500-0223	1
	ARCO/ELMENCO # CM05FD201J03		
C306	CAPACITOR AIR VARIABLE 2-18 pf	1550-0010	1
	E.F. JOHNSON #160-110		
L304	CHOKE 39 mH	1800-0012	1
	MILLER #9210-56		
L302	R.F. CHOKE 100 uH	1800-0253	1
	MILLER #4632		

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TITLE: PM 118-119
OSCILLATOR BOARD

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	03041	F	D.Y.G.H	P.C.T

DRAWN	DATE	SHEET 2 OF 3
	7-13-78	

A 04289 REV B

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
C 301	CRYSTAL 13.56 MHZ	2300-0111	1
E 301-306 308, 309	TERMINAL	2860-2008	8
	H.H. SMITH 2008		
R 303	RESISTOR CARBON COMP. 1K ¼W	4702-0102	1
R 301	" " " " " " 100K ¼W	4702-0104	1
R 307	" " " " " " 75K 1W	4704-0753	1
R 310	" " " " " " 1K 2W	4705-0102	1
R 302	" " " " " " 150Ω 2W	4705-0151	1
R 308	" " " " " " 200K 2W	4705-0204	1
R 304-305	" " " " " " 2.2K 2W	4705-0222	2
R 306	" " " " " " 39K 2W	4705-0393	1
R 309	RESISTOR 20K 5W	4706-0203	1
	OHMITE 4661		
CR 301	DIODE	4800-0013	1
	1N4007		
Q 301	TRANSISTOR	4800-0024	1
	2N5657		
L 303	COIL ¼ of IPC #1800-0007	D 03071	1
	AIRDUX 816 A 12 TURNS		
V 301	OSCILLATOR TUBE	5700-0014	1
	RCA 12 JT6A		
	SCHEMATIC	D03035	REF.

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TITLE: PM 118-119 OSCILLATOR BOARD

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	03041	F	P.Y.G.H.	

DRAWN	DATE	SHEET
	7-13-78	3 OF 3

DIONEX GAS PLASMA SYSTEMS

ENGINEERING PARTS LIST

DWG. NO.	REV.
D 03100	K

REV	DESCRIPTION	DATE	CHK	APPR
K	E.O. 10852	9/80		PGD
J	E.O. #10655, 10870	MS 4-1-80		
I	E.O. 10705	PB 3/80		

REVISION LEVEL

DIONEX GAS PLASMA DIVISION
31158 SAN SENITO
HAYWARD, CALIF. 94544

DRAWN	DATE	TITLE
		PM 119 R. F. GENERATOR TOP ASSEMBLY
CHECKED	DATE	
ENG.	DATE	D / DRAWING NO. 0310Q / REV. K

DO NOT SCALE THIS DRAWING

NEXT ASSY. 03100

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	TOP COVER REAR	C 02940	1.
2	POWER TUBE SUPPORT BRK'T	C 02943	1
3	RF TUNING BAFFLE &	D 02944	1
	FAN SUPPORT BRK'T		1
4	WINDOW BRK'T	C 02945	1
5	TEFLON INSULATOR GEN.	B 02946	1
6	SIDE COVER, RIGHT	C 02948	1
7	MAIN CHASSIS	D 02949	1
8	CHASSIS FRONT PANEL	C 02950	1
9	RFI SHIELD	C 02951	1
10	COIL SUPPORT BAR (FIXED)	C 02952	1
11	COIL SUPPORT BAR (LOWER)	B 02953	1
12	ADJ POT MOUNTING BRK T	B 02954	1
13	REGULATOR BD MOUNTING BRK'	B 02955	1
14	BOTTOM COVER	C 02956	1
15	RF GENERATOR SCREEN BRK'T	B 02959	4
16	RF GENERATOR SKIDS	B 03057	3
17	BEZEL BAR	B 03058	2
18	HIGH VOLTAGE BD MOUNTING	B 03076	4
	BRK'T		
19	FLEXIBLE RF STRAP	B 03077	1
20	NEUTRALIZING CAPACITOR	B 03078	1
	BRK'T		
21	FRONT PANEL BRK'T	B 03081	1
	LEFT		

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TITLE: PM 119 RF GEN. TOP ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	SHEET 3 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
22	RF OUTPUT PLATE	B 03083	1
23	SAFETY SHLD AC POWER	B 03084	1
	STRIP		
24	OUTPUT COIL ADJUSTMENT	B 03085	1
	SCREW		
25	PLATE CAPACITOR BRK'T	B 03082	1
26	OUTPUT COIL TIE STRAP	B 03111	1
27	POWER SWITCH SUPPORT	B 03325	1
	BRK'T		
28	REAR PANEL	C 02942	1
29	FRONT PANEL DECAL	C 02960	1
30	BEZEL DECAL	C 04606	1
31	REAR PANEL SCREENS	B 03050	2
32	NEUTRALIZING CAPACITOR &	B 04302	1
	STRAP		
33	FRONT PANEL BRK'T	B 04608	1
	RIGHT SIDE		
34	TOP COVER FRONT	C 04604	1
35	LEFT SIDE COVER	D 04607	1
36	LOWER COIL SUPPORT	B 04535	1
	SPACER		

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TITLE: PM 119 RF GEN. TOP ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	4 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
37	8 PIN SOCKET	2110-0170	1
	CINCH 8AM		
38	POWER TUBE SOCKET	2110-0200	1
	EIMAC SK800B		
39	QUICK DISCONNECT FEMALE	2120-5075	1
	HOLLINGSWORTH SO-5075		
40	QUICK DISCONNECT MALE	2120-5076	1
	HOLLINGSWORTH SO-5076		
41	INSULATED STANDOFF	2160-0207	5
	USECO 1417-9		
42	MARKER STRIP	2170-0222	1
	CINCH MS 10-142		
43	CONNECTOR UHF F-F	2180-0002	1
	AMPH 29500		
44	CONNECTOR DBL MALE UHF	2180-0024	2 (H)
	DOWKEY F3-125		
45	CONNECTOR UHF BULKHEAD	2180-0190	1
	AMPH 83-798		
46	CONNECTOR ELBOW 90°	2180-0218	1
	AMPH 83-1AP		
47	PWR CABLE CLAMP	2190-0001	1
	ELECTROLINE LS1-2 SCREW		
	CLAMP		

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94544

TITLE: PM 119 RF GEN. TOP ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	SHEET 5 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
48	FURNITURE LEVELER	2800-0005	6
	FRANKIN SILENT GLIDE		
	6242		
50	LAMP CLIP	3900-0006	2
	DIALCO 515-0051 SPEED		
	CLIP		
51	LAMP WASHER	3900-0007	2
	ELDEMA Q145-008		
52	LAMP SOCKET	3900-0005	2
	DIALCO 515-0074		
53	FUSE CLIP	5150-2210	1
	LITTLEFUSE 129002		
54	FUSE HOLDER PANEL	5150-2516	1
	LITTLEFUSE 342038-AL 3AG		
	BUSS HKP		
55	POWER CORD 14 AWG	6000-0020	1
	BELDEN 176295		
56	RESISTOR CLIPS	4760-0001	2
	OHMITS 555		
57	CAPACITOR MT'G RINGS	1525-0002	2
	2" ID		

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TITLE: PM 119 RF GEN TOP ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	6 OF 11

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
58	L3 TO OUTPUT PLATE STRAP	B 04610	1
59	REGULATOR BD SUPPORT	B03374	1
	BRK'T		
C1, 2	CAPACITOR 480μF 450V	1500-0037	2
	MALLORY CG5 481-450		
	DFI		
C5	CAPACITOR 4μF 3000V	1500-0177	1
	ARCO/ELMENCO DM 15-ED101		
	J03		
C6, 7,	CERAMIC TUBULAR CAPACITOR	1500-0191	3
C13	1000pF 5KV		
	CENTRAL 8505-502		
C8, 23	CERAMIC TUBULAR CAPACITOR	1500-0192	2
	50pF 7.5 KV		
	CENTRAL 8585-1000		

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TITLE: PM 119 RF GEN. TOP ASSY

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-16-78	SHEET 7 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
C9, C10,	CERAMIC TUBULAR CAPACITOR	1500-0189	5
C11, C18,	100pF 5KV		
C19	CENTRALAB 8505-100N		
C12	AIR VARIBLE CAPACITOR	1500-0247	1
	EF JOHNSON 154-0003-001		
C20,	CERAMIC DISC .01μF 500V	1500-0001	2
C21	SPRAGUE 5GAS-S10		
C22, C14-C16	CAPACITOR 1000pF 500V ARCO/ELMENCO DM 19FD102J3	1500-0116	4
R2,	POTENTIOMETER 750Ω 2W	4750-0002	3
R3, R5	ALLEN BRADLEY JAIL0405751		
	UC		
R4	POTENTIOMETER 2.5K 2W	4750-0968	1
	OHMITE CLU 2521		
R6	POTENTIOMETER 100K 2W	4750-0001	1
	OHMITE CMU 1041		
R7, R8	RESISTOR 5K 25W	4725-0502	2
	OHMITE 0212		
R10	RESISTOR 10K 25W	4725-0103	1
	OHMITE 0215		

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TITLE				
PM 119 RF GEN TOP ASSY				
SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		
DRAWN	DATE	SHEET 8 OF 11		
JY	8-19-78			

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
R11	RESISTOR 10K 12W	4712-0103	1
	OHMITE 3826		
R12	RESISTOR 500Ω 12W	4712-0501	1
	OHMITE 1730		
R13	RESISTOR CARBON	4704-0334	1
	330K 1W		
L1,5	CHOKE RF 10μH	1800-0006	2
	MILLER 4612		
L2	COIL	1800-0100	1
	AIR DUX 1212A		
L3	INDUCTOR, AIR VARIBLE	C03063	1
L4	CHOKE RF 100μH	1800-0253	1
	MILLER 4632		
TB1	BARRIER STRIP	2170-0193	1
	CINCH 10-142		
TB2	TERMINAL STRIP	2800-0866	1
	CINCH JONES 54C		
CR1,2	DIODE ZENER	4800-0053	2
	FAIRCHILD IN4742A 12V 1W		
DS1,2	LAMP AMBER 115V	3900-0001	2
	DIALCO 507-4537-1433		
K1	TIME DELAY RELAY 120V	4500-0159	1
	POTTER BRUMFIELD		
	CHB 38-7003		

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SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
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A 04289 REV B

ENGINEERING PARTS LIST 0

REF. NO.	DESCRIPTION	PART NO.	QTY.
F1	FUSE 1/10 AMP 3AG	5150-0312	1.
	LITTLE FUSE 312.1000		
S1	POWER SWITCH	5100-0148	1
	POTTER BRUMFIELD		
	112-220-101		
J1	9 PIN (F) PANEL CONNECTOR	2152-2216	1
	AMPH. MS 3102A-22-19S		
J2	4 PIN (M) PANEL CONNECTOR	2152-2417	1
	AMPH MS 3102A-14S-2S		
J3	EDGE CONNECTOR	2100-0223	1
	VECTOR R644 P.C. SOCKET		
T1	POWER TRANSFORMER	CD2933	1
V1	POWER TUBE	5700-0187	1
	EIMAC 4CX1500B		
B1	FAN, PAMOTOR, 7600S	2600-0183	1
	LABELS	6100-0004	1

INTERNATIONAL PLASMA CORPORATION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE: PM 119 RF GEN TOP ASSY

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	SHEET 10 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
A1	HIGH VOLTAGE BD ASS'Y	C03053	1
A2	REGULATOR BD ASS'Y	C06513	1
A3	OSCILLATOR BD ASS'Y	C03041	1
A4	RF COUPLER ASS'Y	C03260	1
REF	SCHEMATIC	D 03035	1
REF	HARNESS	D 03059	1
REF	INSTRUCTION MANUAL	A 03144	1

INTERNATIONAL PLASMA CORPORATION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE: PM 119 RF GEN. TOP ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
D	03100	K		

DRAWN	DATE	SHEET
JV	8-18-78	SHEET 11 OF 11

ENGINEERING PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	QTY.
1	RF COUPLER COVER	B 03257	1
2	RF COUPLER BODY	B 03258	1
3	RF COUPLER CONDUCTOR	B 03259	1
4	NYLON SPACER, .250 THK.	2860-4008	2
	H.H. SMITH #4008		
5	NYLON BHMS	2860-6328	2
	#6-32 x ½"		
C1, C2	CAPACITOR, 1000 MF FEED THRU	1500-0205	2
	ERIE #327-000-X5U0-102M		
J1, J2	UHF CONNECTOR	2180-0190	2
	AMPH #83-798		
R2	RESISTOR, 110 ohm 1 W C.C.	4704-0111	1
R1	POTENTIOMETER	4750-0002	1
	750 ohm A&B TYPE J		
CR1, CR2	DIODE #IN4151	4800-0045	2
6	NYLON #8 WASHER		6
7	#6 SOLDER LUG		2
8	#10 SOLDER LUG		4
9	#318 SOLDER LUG		1
10	#12 GA BUSS WIRE		A/R
11	#18 GA BUSS WIRE		A/R

INTERNATIONAL PLASMA CORPORATION
31159 SAN BENITO
HAYWARD, CALIF.
94544

TITLE: RF COUPLER ASS'Y

SIZE	DWG. NO.	REV.	CHK.	APPR.
C	03260	D	A. Rocha 8-4-78	

DRAWN	DATE	SHEET 2 OF 2
	7-12-78	

S5 12.6V AC
S4 1380V RMS
S3
S2 6.0V AC
S1 1800V RMS
117 V AC
AC NEUT.
S
DS1
B1
CR101
CR102
CR103
CR104
CR125
CR126
C104 100µF 350V DC
C103 20µF 450VDC
C1 480µF 450V
C2 480µF 450VDC
R114 100K 2W
R115 100K 2W
R116 100K 2W
R113 1Ω 5W
R117-121 200K 5W
CR105-124 (20 PLS)
C5 4µF 3KV DC
E101 E102 E103 E104 E105 E106 E107 E108 E110 E111
+450 V DC
+250 VDC
K1
117V AC
R13 330K 1W
DS2
-250V DC
R8 5K 25W
-12VDC
CR2 IN4742A 12V
TB2-2 PA PLATE CURRENT
A1
HV BOARD
ASS'Y 03053-001
+2K VDC
L5 10µH
L1 10µH
C6 1000PF 5KV
C7
L2
R7 5K 25W
CR1 IN4742 A 12V
+12VDC
C17
+250V DC
R10 10K 25W
FI 0.1A
TB1-
TB1-2
TB2-4
R12 500Ω 12W
TB2-3
C13 1000PF
V1
C14
C15
C16 1000PF
C22 1000 PF
6V AC
L3
C23 50 PF
C8 50 PF
C9
C10
C11
C18
C19
C12
L4 100 µH
100 PF (5 PLS)
A4
RF POWER OUT
CR1 IN4151
CR2 IN4151
C2 1000 PF
R2 100Ω
R1 750 Ω
C1 1000 PF
FWD OUT
REFL OUT
+450V DC
TB2-1
E306 E307 E309 E301 E302
L303 12 TURNS
C304 .001µF
L302 100µH
C303 .01µF
R309 20K 5W
C307 47PF
C306 2-18PF
R303 1K 1/4W
V301
X301 13.56 M HZ
R310 1K 2W
R304 2.2K 2W
R305 2.2K 2W
C311 200 PF
R301 100K 1/4W
C301 2200 PF
R302 150Ω 2W
C302 .001 µF
C310 .001 µF
R306 39K 2W
R307 75K 1W
CR301 IN4007
L304 39µH
C309 39pF
C308 .01µF
A3
OSCILLATOR BD.
ASS'Y 03041-001
Q301 2N5657
R308 200K 2W
R11 10K 12W
R6 100K (GRID BIAS ADJ.)
E308 E303 E305 E304
12.6V AC
-250V DC
J1
PM 906
INTERLOCK (DOOR OPEN)
FWD
REFL
PWR
TORR
-12 V DC
0 TO -12 V
+450V DC
120 V AC
R3 750Ω (REFL CAL)
R2 750Ω (FWD CAL)
-12 DC
C207 47 PF 1KV
R222 10 M 1/4W
R201 27K 1/4W
R205 1K 1/4W
C203 10 PF
C201 100 PF
L201 39µH
R203 6.8K 1/4W
R207 27K 1/4W
CR204 IN4151
R220 47K 1/4W
R217 100K (FWD LIMIT)
C205 .001µF 1KV
C213 .001µF 1KV
A201 A
A201 B
+12V
-12V
R211 10 K 1/4W
C209 10µF
C211 100PF
CR201 IN5231B 5.1V
R209 5.1K 1/4W MF
R213 220K 1/4W
Q201 2N 5657
R215 100Ω 1/4W
ASS'Y 03038-004
A2
REGULATOR & VACUUM BD.
J3-12
J3-15
J3-19
J3-21
J3-22
J3-14
J3-20
J3-8
J3-6
R5 750Ω (VAC TRIG)
J3-9
J3-3
J3-7
R404 390K 1/4W
R410 1K 1/4W
R405 4.7K 1/4W
C405 22µF 16V DC
C404 .1µF
C401 1000 PF
R406 3.3K 1/4W
Q401 2N 5657
R407 10K 5W
L401 39µH
R415 390K 1/4W
R414 1K
C409 22µF 10V
R411 4.7K
R412 3.3K 1/4W
Q402 2N4921
R413 100Ω 1/4W
C407 .1µF
C408 1000 PF
L404 39µH
R409 680Ω 1/4W
+12 V DC
J3-16
-12 V DC
J3-10
R408 680Ω 1/4W
R401 10K 1/4W
R402 22K 1/4W
R403 10K 1/4W
C403 .05 µF
C402 .05 µF
J3-5
L202 39µH
R204 1.5K 1/4W
R202 27K 1/4W
C204 10PF
C202 100µF
C206 .001µF 1KV
R206 1K 1/4W
R218 50K (REFL LIMIT)
R219 100K 1/4W
R221 47K 1/4W
C208 47 PF 1KV
R212 10K 1/4W
C210 10 PF
C212 100PF
CR203 IN4151
CR202 IN5231B 5.1V
R200 27K 1/4W
R210 5.1K 1/4W
R214 220K 1/4W
Q202 2N5657
R216 100Ω 1/4W
R4 2.5K (VAC CAL)
T401
(BLU)
(BLK)
(GRN)
(RED)
(WHT)
L402 39 µH
L403 39µH
C406 .01µF
J3-4
J3-8
J3-2
J3-1
J2
A
B
C
D

REV	DESCRIPTION	PREP	DATE
J	ECR 10341	JV	
H	ECR 02140	JV	
G	ECR 10272	JV	
F	ECR 10234	JV	
E	ECR 02140	JV	
D	EO 10236 10206 10207	JV	8-14-87

PREP
CHECK
APPR

INTERNATIONAL PLASMA CORP.

ELECTRICAL SCHEMATIC
PM119 R.F. GENERATOR
2000 & 4000 SERIES

D
03035

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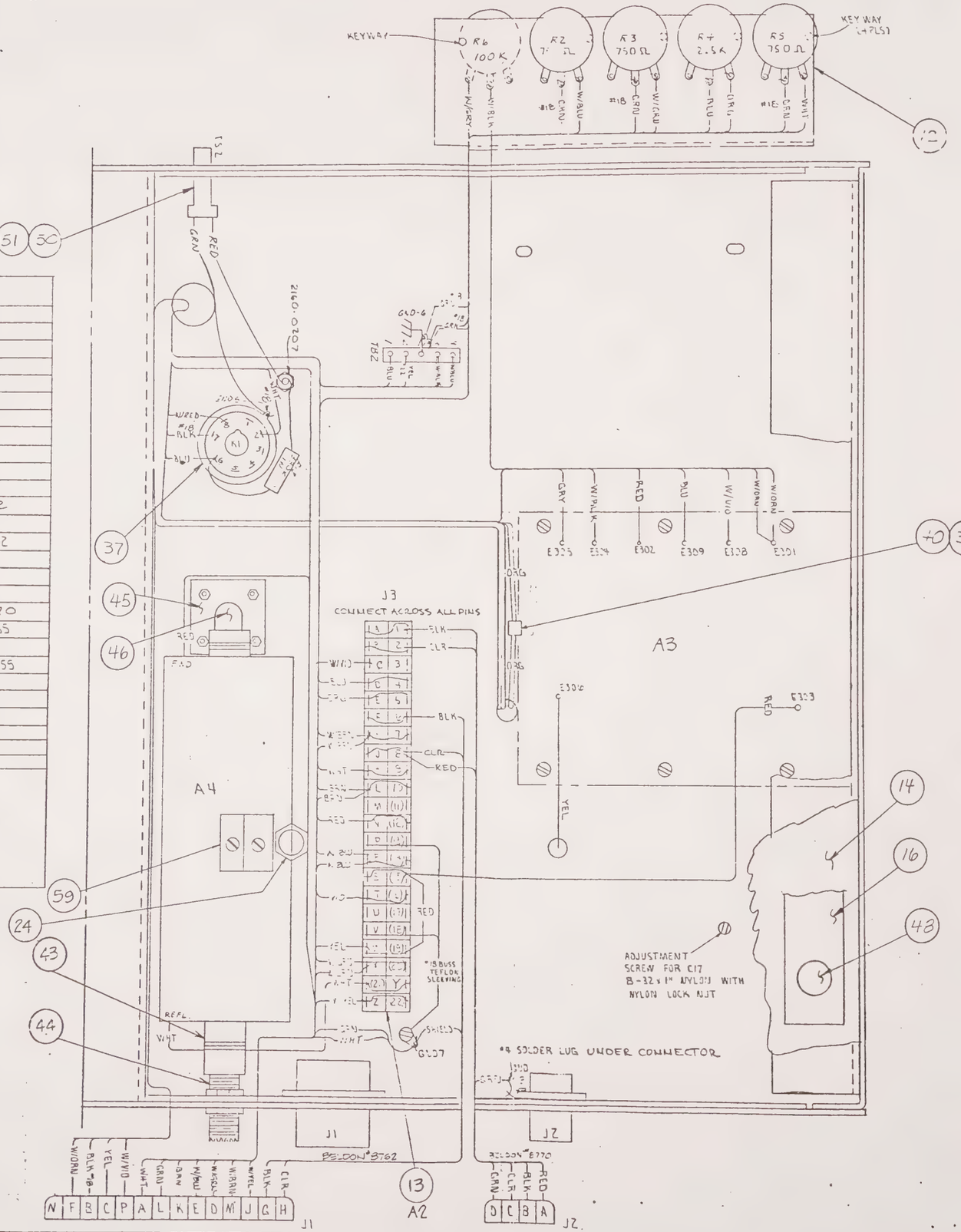
WIRE LIST

COLOR	START	BREAK OUT AT	END	NOTES
BLK	J3-4, D		R4	
CLR	R4		J3-S,E	
WHT	J3-9, K		R5	
GRN #18	Z3		GND-6	
RED	J3-12, N		A4-FWD	
W/BLU	Z2	J3-14, R	J1-E	
BLU	J3-19, W	JUMPER TO J3-15, S	E303	
W/GRN	Z3	J3-20, X	J1-D	
WHT	J3-21, Y		A4-REFL	
W/RED	J3-22, Z		J1-J	
ORG	J3-8, J		J1-H	BELDON 8762
BRN	J3-10, F		J1-G	↕
SHLD	GND-7			BELDON 8772
RED	J3-8, J		J2-A	BELDON 8770
BRN	J3-1, A		J2-B	↕
CLR	J3-2, B		J2-C	↕
GRN	J2-D		GND-E	BELDON 8770
YEL	E304		C17	NOT IN HARNESS
RED	D32		Z13	↓ ↓
GRN	D32		GND-5	NOT IN HARNESS
BLU	E309		TB2-1	
W/BLK	R6		E304	
GRN #8	R1		GND-6	
GRN #18	R5		GND-6	
W/10	J3-3		J1-P	
WHT	J1-A		GN27	
	TB1-1		TB1-2	
	TB1-3		TB1-4	
	TB1-4		TB1-5	JUMPER
	TB1-5		TB1-6	
	TB1-7		TB1-8	
	TB1-8		TB1-9	
	TB1-9		TB1-10	



3 INSULATED SLIP ON CONNECTOR IPC#2120-5075 & 2120-5076
2 MOUNT BACK PANEL PLUGS WITH KEYWAYS ON UP POSITION WHEN MACHINE IS IN OPERATING POSITION
1 ALL WIRES FROM J3 22 GA. UNLESS OTHERWISE SPECIFIED

FIND NO.	NOTES		
PREP			INTERNATIONAL PLASMA CORP. HAYWARD, CALIFORNIA
CHECK			
APPR			TITLE: PM 113 TOP ASS'Y AND WIRE LISTS
MATERIAL			
FINISH			SIZE D · DRAWING NO D3107 · REV H
			SCALE · SHEET 2 OF 11

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REV	DESCRIPTION	PRP'D	DATE	APP'R
B	REVISED	JJ	5-17-79	
C	EO #12203, 12304, 12520	JJ	6-5-79	
D	ADD C19 + C20 PARTS W/ S.L.a	JV	9-30-80	EFC
E	[illegible]	[illegible]	2-10-82	[illegible]
F	EO# 10318-1	JV	5-13-82	
G	EO# 12246	JV	8-20-82	JV/EH
H	EO 10512	KG	3-28-84	

MAR 17 1980

WIRE LIST				
COLOR	START	BREAK OUT AT	END	NOTES
BLK	AC POWER CORD		S1-BOTTOM	BELDON 8303 + 8223
WHT			T1-2	↓
GRN	AC POWER CORD		GND-1	BELDON 8303 + 8223
BLK #18	TB1-10		T1-2	
WHT #14	TB1-5		T1-1	
BLK #14	S1-TAP		TB1-7	
BLK #22	DS1		TB1-7	
WHT #22	DS1		TB1-5	
#18 BLK	TB1-8		K1-7	
#18 WHT	TB1-3		K1-2	
FAN	B1		TB1-4	NOT IN HARNESS
FAN	B1		TB1-9	NOT IN HARNESS
BLK #18	T1-12		J1-B	
WHT #18	T1-13		GND	
GRN	J1-L		GND-7	
GRN	T1-5		GND-1	
W/VIO	T1-6		E308	
BLU #16	T1-7		V1-GND	
ORG #14	T1-8		V1-FIL	SLIP ON CONNECTOR
YEL	J3-19		J1-C	
	T1-3		E104	BELDON 8858
	T1-4		E105	BELDON 8858
ORG	T1-9		E101	
GRN	T1-10	E102, C11(-), C2(+)	GND-1	
RED	T1-11		E103	
	C5		E110	BELDON 2592
	C5		C6	BELDON 8892
GRN	C5		GND-4	NOT IN HARNESS
W/GRY	E108	C2(-), R11-A, R8-A	R6	
W/RED	E107	C1(+), R10-A	K1-8	
W/BLK	R12-B	TB2-3	W-SCREEN	
RED	F1-A	TB1-1	E302	
VIO #22	CR1	R7-B	J3-16, T	
BRN #22	R8-B	J3-10, L	J1-K	
W/BRN #22	R10-B	J3-7, H	J1-M	
GRY	R11-B		E305	
W/ORG	E106	E301	J1-F	
	C7		L2	BELDON 8898
	C13		L2	BELDON 8898
BRN	R8-B		CR2	JUMPER
YEL #22	E111		T32-2	
BLU	F1-B		K1-6	
W/BLU	TB1-2	R12-A	TB2-4	
W/BLU	R12-A		R7-A	JUMPER

2 USE TEFLON SLEEVING ON ALL JUMPER
1 ALL WIRES ARE 18 GA.
UNLESS OTHERWISE SPECIFIED

FIND NO.	NOTES
PREP	
CHECK	E. Fonseca 2/20/79
APPR	[illegible] 2/21/79
MATERIAL	
FINISH	

INTERNATIONAL PLASMA CORP.
HAYWARD, CALIFORNIA

TITLE: PM 1/8
TOP ASS'Y AND WIRE LISTS

SIZE D | DRAWING NO. 03100 | REV H

D 003100 H